

# JOM

JUNE 2020

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An official publication of The Minerals, Metals & Materials Society



**TMS2020 HIGHLIGHTS: ANOTHER RECORD YEAR IN SAN DIEGO**





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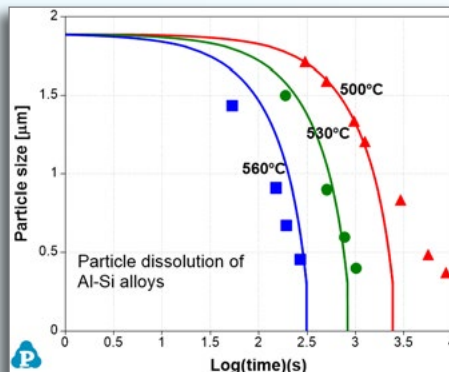
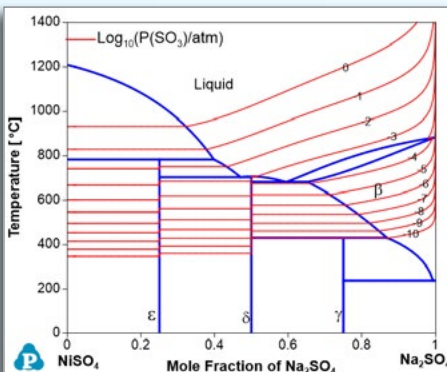
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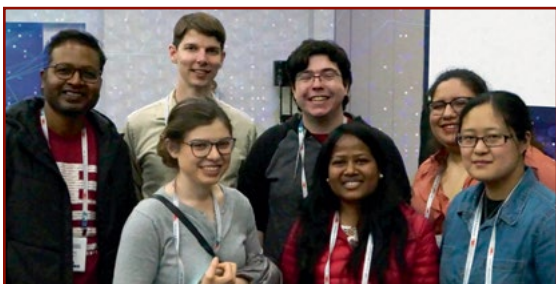
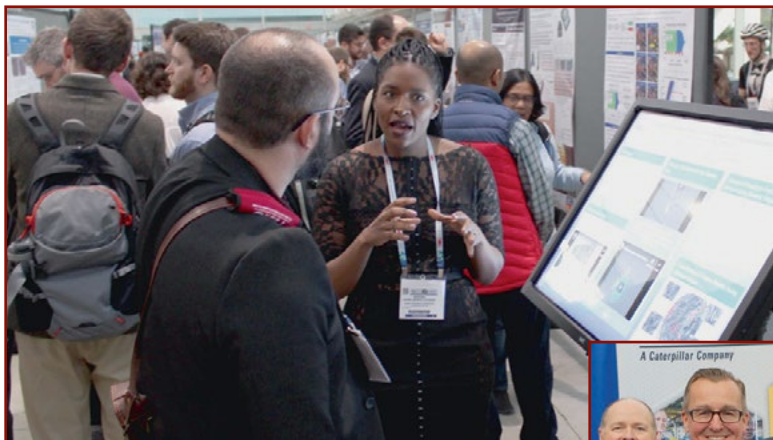
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## **About the Cover**

The photos on this cover represent a collage of networking events, technical presentations, and awards activities from the TMS 2020 Annual Meeting & Exhibition (TMS2020), held February 23–27, in San Diego, California. Five articles in this issue present just some of the meeting's many highlights. For an even fuller picture of TMS2020, browse hundreds of photos at [www.flickr.com/photos/TMSevents](http://www.flickr.com/photos/TMSevents).



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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.

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# in the final analysis

*"The purpose of life is not to be happy. It is to be useful, to be honorable, to be compassionate, to have it make some difference that you have lived and lived well."*

—Ralph Waldo Emerson

In many ways, Emerson's observation on the purpose of life applies not just to responsible individuals but also to organizations that seek to pursue the greater good. It certainly applies to nonprofit organizations like TMS. Annually, TMS endeavors to be useful in many ways: By convening the materials community to network and collaborate on tasks that serve the good of the order, by building excellence in education, by helping industries be more efficient, by enforcing rigor in technical communication, by advancing professionalism, and by inspiring the pipeline of future professionals. Coming into 2020, we had many strategies, tactics, programs, and initiatives to do these very things. As always, they would be powered by members, volunteers, staff, and other stakeholders.

But, one strategy that we lacked was how to be useful to our materials science and engineering community in the event of a pandemic. No tools in the TMS toolbox for that one. But tools we did need, and we needed them the day before yesterday. What could TMS do during those early shutdown days of late March and April . . . something useful? Something honorable? Something compassionate? Something that made a difference? As I've learned, I think that we have answered "yes" to all.

The first order of business was to keep our business in business. Like many associations, the 2020 TMS calendar of activities was run through a shredder during March and continuing into the second quarter. Through the work of our volunteer and staff leadership, we have worked to leverage new government programs, dial back on discretionary activities, and generally recalibrate our plans for 2020. The Society is still conducting its essential business, is restructuring its events calendar, is planning for future disruptions, and is retaining our staff. The goal: When COVID-19 is ultimately suppressed and the deep bruises to our global establishments are healed, TMS will be in the position of continuing and growing its mission to serve the community as set in motion 150 years ago next year.

Knowing that the lights would stay on, the second order of business was to look toward what we could do quickly to serve our membership meaningfully and altruistically. We couldn't do anything about two-ply shortages, but we could help members connect with the professional community and access professional development tools. Inspired by member requests, we launched the free-to-members Webinar Library, which gathers a number of past educational webinars (that were either too hard to find on our web site or that had paywalls). In complement, we rapid-developed a timely new webinar, Transitioning to Online Instruction: Tips, Tools, and Techniques. We also created the COVID-19 Resource Portal, promoting virtual networking by using TMS tools available to members (e.g., the membership directory and the committee listservs) and engaging social media (e.g., using the #GoodNews hashtag to promote how the materials community is contributing to the fight against COVID-19).

Our third order of business, as of this writing in mid-April, was to look beyond the traditional boundaries of TMS and toward the greater good of our world at large. Again, by leveraging member inputs, we launched the TMS COVID-19 Materials Needs Exchange website. COVID-19 is a problem that is reflexively thought of as a challenge for the biological and health sciences. However, as with so many problems, materials science and engineering can play a significant role in defeating it and maybe help save lives in the process. The Materials Needs Exchange acts as a clearinghouse to connect organizations and programs on the front lines of the COVID-19 pandemic with TMS members who are willing to render materials or manufacturing assistance, resources, and/or expertise.

Useful, honorable, compassionate, and making a difference . . . I hope that is how we judge our collective response to our era's pandemic. If so, perhaps we will add "happy" to that list.

# JOMI

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James J. Robinson  
Executive Director

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*"Like many associations, the 2020 TMS calendar of activities was run through a shredder during March and continuing into the second quarter."*



# Venkatesh Vijayaraghavan Examines the Exciting Field of Computational Engineering

Kaitlin Calva



Venkatesh Vijayaraghavan

## young professional technical notes

This occasional feature highlights the scientific interests and professional accomplishments of a young TMS member who has contributed to the technical content of the current issue of *JOM* as an author, advisor, or guest editor. The development of this feature is a special project of the TMS Young Professionals Committee. For additional information contact Kaitlin Calva, *JOM* Magazine Managing Editor, at [kcalva@tms.org](mailto:kcalva@tms.org).

"I have always been fascinated by computational techniques in engineering, regardless of domain, such as mechanical, structural, chemical, or energy engineering," said Venkatesh Vijayaraghavan, a faculty fellow at the University of New South Wales (UNSW). In his June 2020 paper, "Tensile Properties of Boron Nitride–Carbon Nanosheet Reinforced Aluminum Nanocomposites using Molecular Dynamics Simulation," Vijayaraghavan explores mechanical properties of novel nanocomposites using computer simulation techniques.

"This paper highlights some of the critical aspects which should be considered to accurately characterize the mechanics of boron nitride nanocomposites using computational modelling," he said. "The modelling framework used in the article could be adopted by practicing materials engineers and scientists who can further improve upon it while working using more complex, multiscale models."

"For the case of mechanics of nanomaterials, it is indeed very difficult to conduct real-world experiments due to the scale of the material. As computational modelling has evolved as a powerful tool in estimating strength characteristics of novel nanostructures, it is also important to ensure the reliability which can promote its wide-scale applications," Vijayaraghavan explained. "Also, the other interesting fact about computational modelling is that it is possible to virtually design a completely new material and test its responses to a particular loading nature. With new advancements every day in computer infrastructures, this field has become even more exciting."

Looking at the myriad possibilities and challenges facing the rapidly changing field of computational modelling, Vijayaraghavan observed that "there is a significant opportunity for students and the academic community at large." However,

he continued: "Equally challenging is the fact that it is also important to ensure how well the virtual engineering research can translate to a real-world scenario, since ultimately this is what it counts."

Noting the influence that mentoring has had on his career, Vijayaraghavan credited Wong Chee How, his Ph.D. advisor at Nanyang Technological University, with introducing him to the field of computational engineering. And his current mentor at UNSW, Liangchi Zhang, has been a great resource in "providing useful guidance whenever needed."

Vijayaraghavan also referenced other helpful resources for career guidance, such as his membership in TMS, where TMS journals have helped to keep him in touch with recent advancements in the field. He also thanked Nikhil Gupta, New York University, and Robert Maass, University of Illinois at Urbana-Champaign, for their guidance on the benefits of being a TMS member as an early-career researcher in the field of materials engineering.

Along with these mentoring resources, Vijayaraghavan said that networking and collaborating on projects whenever possible are vital tools for scientists and engineers working in all sectors. "By working with a diversified group, I have been able to get valuable inputs while also concentrating on research projects which have been of high relevance to current needs and challenges."

In addition to seeking opportunities for collaboration, Vijayaraghavan left this parting thought for other scientists and engineers starting out in the field: "As a young researcher, we would be under constant pressure to publish and disseminate the research findings, as it forms the important output or measure of success. However, it is also important to focus on the relevance of work, as some universities around the world are now focusing more on the citation metrics rather than the actual count of published articles itself."



# Getting to the Heart of It: TMS Foundation Thanks 2019 Donors



Kaitlin Calva



Each year, the TMS Foundation family gathers for its donor dinner event at the TMS annual meeting to celebrate those who make a difference. “You have distinguished yourselves as scientists, mentors, leaders, and philanthropists,” said Garry Warren, TMS Foundation Board of Trustees Chair, as he welcomed and thanked the night’s guests. “Your commitment to the TMS Foundation reflects your passion to introduce young people to the materials science and engineering community and to sustain them in the profession through their formative years.”

The passion of these top donors is what keeps the TMS Foundation going; without their continued support, the Foundation could not provide the financial assistance, leadership development opportunities, or early career recognition that it does. Through this support at the most critical stages of career development, the Foundation is the steppingstone for many individuals to take on new roles

within their education, workplace, or the Society.

Warren then introduced Paul Ohodnicki, associate professor of mechanical engineering and materials science at the University of Pittsburgh, who benefitted from Foundation support as a 2010 Young Leaders Professional Development Award recipient.

“Receiving that award as a young engineer working in industry during the financial crisis provided me with an opportunity to attend both the TMS Annual Meeting and MS&T at a time when it would have been too difficult for my employer to justify attendance. It also allowed me to become immersed in the TMS volunteer leadership activities and to expand my professional network within the TMS community,” he said. “As an active TMS member, I subsequently took on a number of volunteer and leadership roles. And as a result of the connections and relationships built through my TMS involvement, I was able to identify a number of career opportunities within both the government and academic sectors.”

Warren noted that Ohodnicki “is on a path we love to see—he first joined TMS as a student, he has stayed involved as a volunteer throughout school and career and is giving back as a donor.” Ohodnicki added: “At this point in my career, I am actively donating to the TMS Foundation and also have accepted a position as chair of the Functional



Robyn and Rob Wagoner (pictured above center, right) receive their pin as members of the TMS Foundation Diamond Society from Paul Ohodnicki (left), recognizing lifetime giving to the Foundation of \$100,000 or more. As constant supporters of the Foundation since its creation in 1995, Rob has served as chair of the Revitalization Committee and then as Board of Trustees chair. “We can proudly say that Rob is the architect of the Foundation’s revitalization,” said Garry Warren. “Rob strategized and urged the Foundation forward with vigor and determination, all the while donating generously.”

## Join the Next Celebration

The TMS Foundation Donor Recognition Dinner is held in conjunction with the TMS annual meeting to formally welcome new members to the TMS Foundation Lifetime Giving Honorary Societies and to thank all donors in the preceding year for their generosity and support. You can be a part of the next celebration at the TMS 2021 Annual Meeting & Exhibition (TMS2021), March 14–18, 2021, in Orlando, Florida, by making a gift of \$1,000 or more or joining one of the TMS Foundation honorary societies.

To get special benefits as a TMS2021 attendee in addition to an invitation to the donor dinner, become a VIP Donor with a contribution of \$2,000 or more in 2020. Visit [www.TMSFoundation.org](http://www.TMSFoundation.org) for more details or to make a donation online today.

Donald Sadoway took the opportunity to say thank you to his past students and supporters for starting a new award in his honor, the Sadoway Materials Innovation and Advocacy Award, in 2019.



Materials Division and as a new Board of Directors member for TMS because I want to give back and ensure that the next generation of engineers can access the types of opportunities that I was privileged to receive as a young engineer.”

Another highlight for the TMS Foundation in 2019 was the launch of fundraising efforts for a new Society-level award—the Sadoway Materials Innovation and Advocacy Award, named in honor of Donald Sadoway. Jim Yurko, one of Sadoway’s former students, shared his own experience with the TMS Foundation: “I have benefited tremendously from the TMS Foundation and its programs, which have helped me grow professionally and make great friends along the way with fellow materials professionals,” he said. “As my career has progressed, it’s been a priority to give back to the TMS Foundation and help the next generation.”

Along with David DeYoung, a fellow past student of Sadoway’s, Yurko is leading the fundraising for the award and acknowledged that the Foundation is the perfect home for such recognition opportunities. “If you think about the mission statement of the Foundation, and if you know Don Sadoway and his career path and focus, you easily spot an alignment. Education, mentorship, and support of students and young professionals. Promoting the field of materials science and its impact on society.”

Sadoway also offered a few comments, thanking his past students and supporters of the award for their dedication to establishing such an honor in his name. “Throughout my career I’ve cultivated the notion that

engineering is science in service to society, not science in service of career building—chasing after number of publications, number of citations. I’m thrilled that TMS has created this award to recognize people whose work embodies the fusion of engineering R&D, engineering education, and technological advocacy,” Sadoway said. “I am honored to see the establishment of a TMS award with my name on it. This is a humbling experience for me.”

Before the end of the evening’s festivities, Warren and Ohodnicki presented the 2019 TMS Foundation Lifetime Giving Honorable Society inductees with their society pins. “Please know that every thanks from a recipient to the Foundation echoes back to you. When they say, ‘I hope to contribute to the field in the future,’ you helped open that path to the future. When they say, ‘this gives credibility to my work and enriches my learning,’ you are the enricher. And when they say that they see the TMS Foundation as a great resource and system of support, you are the resource and support. You are the heart of the profession, and we thank you.”

“As the top donors to the TMS Foundation, you provide opportunity and recognition for the enrichment and advancement of our membership,” said Warren, reiterating the night’s message of gratitude. “You are at the heart of this profession and give those who benefit a sense of belonging to something important. Thank you for your energy, philanthropic spirit, and caring.”

The 2019 inductees are pictured below, left to right: Anne and Jonathan Dantzig, Silver Society; Mary and Robert Shull, Titanium Society; Robyn and Rob Wagoner, Diamond Society; Deepa and Brajendra Mishra, Gold Society; John Hryn, Silver Society; Joan and James Yurko, Titanium Society; Jim Foley, Silver Society; David Shifler, Gold Society; Luis Ortiz, Silver Society; and Antoine Allamore, Silver Society. Not pictured are: Cynthia Bognar, Titanium Society; David DeYoung, Titanium Society; Christopher Schuh, Silver Society; and Ingo Wender, Silver Society.



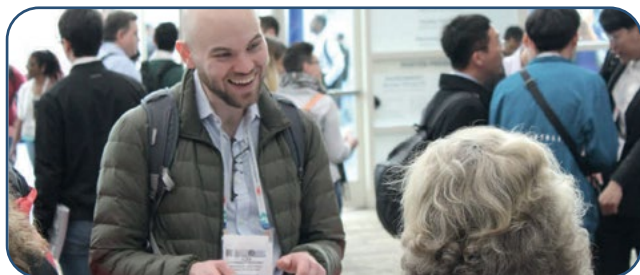
The TMS Foundation welcomed new members to its Lifetime Giving Honorable Societies during the Donor Appreciation Dinner held at TMS2020 in February.







A total of 4,680 attendees gathered in San Diego, California, for the TMS 2020 Annual Meeting & Exhibition (TMS2020), February 23–27, making it the most well-attended annual meeting in TMS history, despite travel restrictions related to the COVID-19 outbreak that prevented the participation of colleagues from China.



A traditionally popular site for TMS Annual Meetings, San Diego was also the location of the Society's second-largest meeting in 2017, and TMS will return to the city in 2023. In this established venue, TMS welcomed programming developed with long-term partners, piloted new approaches to its long-standing poster event and to several of its technical sessions, and introduced new programming elements.

## PbZn 2020 and Electrometallurgy 2020

TMS2020 hosted the 9th International Symposium on Lead and Zinc Processing (PbZn 2020) and the 3rd International Symposium on Electrometallurgy (Electrometallurgy 2020), both organized in cooperation with partner societies.

PbZn 2020 held 19 technical sessions, one poster session, and three plenaries throughout the week. This conference-within-a-conference also featured the well-attended networking event, PuBZoNe; two short courses on lead and zinc processing; and a tour of Teck Trail Operations in British Columbia, Canada, following the close of TMS2020.

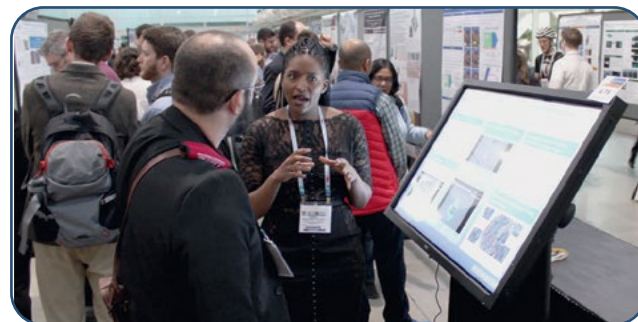
PbZn 2020 was organized by TMS, with sponsorship from the Hydrometallurgy and Electrometallurgy Committee, and the Pyrometallurgy Committee and co-organized by the Metallurgy & Materials Society's Canadian Institute of Mining, Metallurgy and Petroleum (MetSoc of CIM); Gesellschaft der Metallurgen und Bergleute; and the Mining and Materials Processing Institute of Japan.

The Nonferrous Metals Society of China was a co-sponsoring society for 2020, and, though participants from China were unable to participate in TMS2020 due to travel restrictions, PbZn 2020 organizers announced that the 2023 installment of the symposium will be held in China with the Nonferrous Metals Society acting as the main organizing society.

Electrometallurgy 2020 featured two days of sessions on hydrometallurgy, molten salts, and applications to battery or materials synthesis, followed by the two-day symposium Process Metallurgy and Electrochemistry of Molten Salts, Liquid Metal Batteries, and Extra-Terrestrial Materials Processing: An Extraction & Processing Division Symposium in Honor of Don Sadoway.

This symposium was organized by TMS and MetSoc of CIM, with leadership from the TMS Extraction & Processing Division and support from the Hydrometallurgy and Electrometallurgy, Process Modeling and Technology, and Pyrometallurgy committees of TMS.

## The Diffusion Zone Poster Session



TMS previewed several elements of The Diffusion Zone, a new concept for the TMS poster session, at TMS2020. This included a display of digital posters that attendees could view and interact with on a touch-screen monitor. Invited posters were placed throughout the displays of contributed posters, bringing work from well-known presenters into the aisles. A virtual reality demonstration from Garritt Tucker of Colorado School of Mines allowed participants to explore microstructures, mineral phases, chemical segregation maps, and more. Finally, a rating system that could be accessed through the TMS2020 App allowed attendees to leave positive feedback on posters with just a few taps on their phones.



The Diffusion Zone elements at this year's conference were only a preview, however; the full Diffusion Zone concept will debut next year at the TMS 2021 Annual Meeting & Exhibition, which will be held in Orlando, Florida, March 14–18.

## Silent Sessions



While the Diffusion Zone elements made the TMS2020 poster session a bustling, busy event, elsewhere in the San Diego Convention Center a much quieter program was being piloted: TMS Silent Sessions.

While most of the conference's oral presentations were delivered in their traditional format, select sessions in the Characterization and Nuclear Materials technical tracks were held in a single hall converted into ten smaller presentation spaces. In this space, presenters talked at normal speaking volume into a microphone, but instead of amplifying their voices, the microphone transmitted their words to a receiver. Listeners could then hear the presentation through a set of headphones at their preferred volume level.

Because moving between presentations was as easy as switching the receiver to the next channel, this arrangement made it easy for attendees to sample a number of different presentations in their interest area without having to leave the room. The setup also allowed participants with similar interests to network in a shared space at the center of the room.

## New Programming

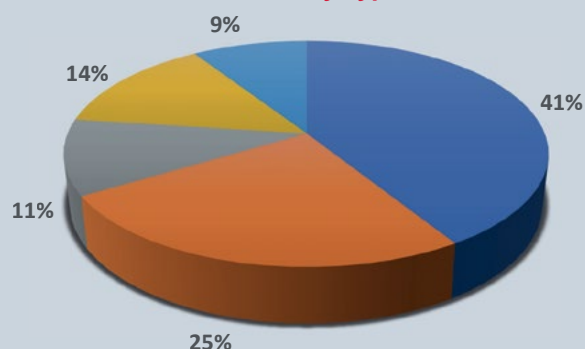
Also new to this year's conference was Thursday's Materials and Manufacturing Innovation Spotlight Luncheon, which featured three invited speakers who explored the concepts and technologies that are revolutionizing the materials and manufacturing arenas, and a pair of symposia developed as part of the inaugural Frontiers of Materials Award. These events are covered in more detail in the article "Keynotes and Featured Talks at TMS2020" in the June issue of *JOM*.

The June issue of *JOM* offers a series of articles showing the people and events that made up the complete TMS2020 event. For an even fuller picture of TMS2020, browse hundreds of photos from networking events, award presentations, and other meeting activities at [www.flickr.com/photos/TMSevents](http://www.flickr.com/photos/TMSevents).

## TMS2020 by the Numbers

A quick look at the numbers shows who attended TMS2020 and the types of presentations they experienced.

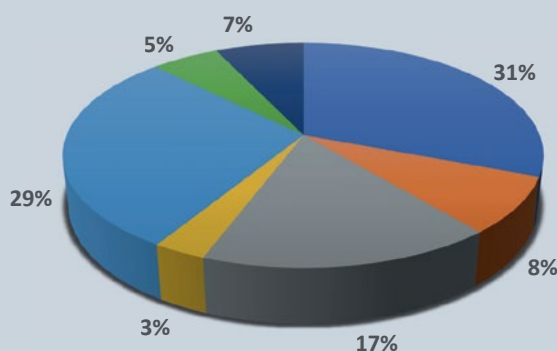
### TMS2020 Presentations by Type



Presentation Type

Oral	1,593	41%
Invited	970	25%
Poster	418	11%
Student Oral	534	14%
Student Poster	352	9%

### TMS2020 Attendees by Member Type



Attendee Type

Member	1,431	31%
Non-Member	377	8%
Non-Member Author	780	17%
Daily	141	3%
Student	1,336	29%
Exhibitors	252	5%
Other	328	7%



## TMS Installs New Leadership



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

Tom Battle (pictured above, left), extractive metallurgy consultant, was installed as 2020 TMS President during the TMS-AIME (American Institute of Mining, Metallurgical, and Petroleum Engineers) Awards Ceremony at TMS2020. A member of TMS for more than 30 years, Battle has been active in the Extraction & Processing Division (EPD) Council for nearly 20 years, serving in a number of leadership roles that culminated in his 2008–2011 TMS Board of Directors service as the EPD Chair.



Battle addressed TMS2020 attendees at the awards ceremony, encouraging his fellow members to get involved with the Society. "TMS is an organization that is mainly driven from the bottom up, so we rely on our volunteer members at the technical committee level to help the rest of the organization and the Board to move forward," said Battle. "Now is a great time for you to become more involved with the Society."

As Battle's presidential year began, James C. Foley (pictured, right), of Los Alamos National Laboratory, ended his term as 2019 TMS president by looking back at what the Society as a whole has done and what he personally has achieved in the past year. He also acknowledged the contributions of all of the Society's volunteers. "No matter what form it takes, I'd encourage each and every one of you to continue making contributions, in your own way, according to your own plan, in the coming year. I know I will."

The change in TMS leadership also included Ellen Cerreta, Los Alamos National Laboratory, moving into the role of 2020 TMS Vice President. Cerreta will serve as TMS president in 2021.



The TMS Board of Directors made the transition from the 2019 to the 2020 board during its meeting on February 27. Pictured are board members from both years, from left to right: John A. Howarter, Chester J. Van Tyne, Raymundo Arróyave, James J. Robinson, David L. Bourell, Eric Nyberg, Judith Schneider, Christina Meskers, Alexis C. Lewis, Eric N. Brown, Ellen K. Cerreta, Thomas Battle, James C. Foley, Brad L. Boyce, Daniel Miracle, Paul R. Ohodnicki Jr., Mark R. Stoudt, Kevin J. Hemker, Charles H. Ward, Adrian C. Deney, and Michele V. Manuel.

## Short Courses Offer In-Depth Learning



Andreas Siegmund (pictured left), LanMetCon LLC, provided instruction as part of the two-day Lead Processing short course, held on Saturday and Sunday, February 22 and 23, prior to the start of TMS2020 technical programming. This course and the one-day Zinc Processing course were designed to complement presentations given at the 9th International Symposium on Lead and Zinc Processing held in conjunction with TMS2020. In total, 195 participants attended seven workshops and short courses over the course of two days on topics ranging from light metals and additive manufacturing to modeling and lead-free solders.



## TMS2020 Proceedings

Eleven TMS2020 proceedings volumes were published and made available for free online access to conference attendees. These volumes are now available for purchase through the TMS Bookstore. TMS members are eligible for 40% discounts on these and other TMS proceedings, as well as 20% off all other Springer products. Log in to [www.tms.org/Bookstore](http://www.tms.org/Bookstore) to access your member discount codes.

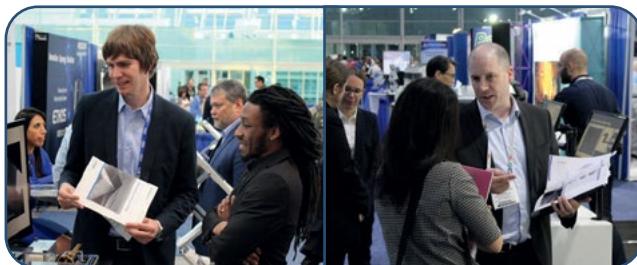


2019 TMS President James C. Foley (right) presents a copy of the *Light Metals 2020* proceedings volume to the book's editor Alan Tomsett, Rio Tinto Pacific Operations, during the TMS Aluminum Committee meeting.



Foley also presented a copy of the *Magnesium Technology 2020* proceedings to the volume's editors during the Magnesium Committee meeting. Pictured from left to right are editors Neale R. Neelameggham, Victoria Miller, J. Brian Jordon, Foley, and Vineet Joshi.

## TMS2020 Exhibit



The TMS 2020 Exhibit Hall featured 80 exhibiting companies and was open Monday through Wednesday, February 24–26. The hall acted as a hub for meeting with clients, discussing new technologies, and displaying products and services. This year, the exhibit hall hosted two poster sessions, an opening reception, a happy hour, and three lunches to bring attendees together with exhibitors.



# MAKE PLANS FOR TMS2021

Plans are now underway for the TMS 2021 Annual Meeting & Exhibition (TMS2021), which marks the 150th anniversary for the TMS Annual Meeting. A number of special anniversary features are planned for this historic installment of the conference, and two events will be co-located with TMS2021: the 5th International Symposium on Nickel and Cobalt (Ni-Co 2021) and Diversity in the Minerals, Metals, and Materials Professions 4 (DMMM4). Also planned for next year is the 2021 TMS Bladesmithing Competition. Information about participating in the event is available at [www.tms.org/Bladesmithing](http://www.tms.org/Bladesmithing).

**Ni-Co 2021**  
THE 5TH INTERNATIONAL SYMPOSIUM ON NICKEL AND COBALT

**DIVERSITY**  
IN THE MINERALS, METALS, AND MATERIALS PROFESSIONS

**TMS BLADESMITHING COMPETITION**

TMS2021 will be held at the Orlando World Center Marriott in Orlando, Florida, March 14–18, 2021. You can begin planning today:

- Book your housing now to reserve your place at the Orlando World Center Marriott and stay in the center of the action
- Submit an abstract by July 1 to present your work at TMS2021

Visit [www.tms.org/TMS2021](http://www.tms.org/TMS2021) to browse symposium plans, submit an abstract, or make your housing reservation.







Exploring materials engineering challenges and innovations in the gas turbine production industry was the primary focus of the TMS 2020 Annual Meeting & Exhibition (TMS2020) all-conference plenary presentation, “Leveraging Materials Innovation to Drive Industrial Gas Turbine Performance and Secure a Sustainable Future,” held Monday, February 24, 2020. The talk was delivered by John Mason, director, Gas Turbine Products Engineering at Solar Turbines Incorporated.

While not a materials scientist or engineer himself—his background is in mechanical engineering—Mason said he works with teams of both at Solar Turbines, a Caterpillar company. Solar is the world’s largest manufacturer of industrial gas turbines, and it focuses on sustainable energy solutions for the power generation and oil and gas markets.

Mason examined global energy trends that predict demand will increase 25% by 2040, due to population growth, increased economic growth and prosperity, and an increased demand for energy to produce plastics.<sup>1</sup> This demand, Mason stated, will be satisfied by a balanced portfolio, with the fastest growth in the next 20 years coming from renewables and natural gas, while oil growth is expected to plateau in the 2030s.

Globally, the demand for natural gas is expected to increase 50% by 2040.<sup>1</sup> Investment in oil and gas, Mason noted, saw a big increase between 2009 and 2014. While there is short-term growth for oil, he pointed out, there is a long-term demand for gas.<sup>2</sup> Solar Turbines, which has produced gas turbines for decades, sees itself as an energy solutions provider to these industries.

Next, Mason looked at some of the materials challenges that Solar Turbines has faced in the past. One such challenge was developing more capable superalloys that can withstand

higher gas turbine operating temperatures. New tools such as calculation of phase diagrams (CALPHAD) and integrated computational materials engineering (ICME) helped them overcome some of these issues.



John Mason, Solar Turbines Inc., delivers the all-conference plenary at TMS2020.

“Decades ago, surface durability reared its head,” said Mason. While materials engineers solved this problem, he said, it was replaced by new problems related to hot corrosion. Eventually higher chromium superalloys were developed in response. Materials engineers were also needed to develop new technologies in melting because advances in superalloy development required special melting processes. Developing better protective coatings and coating application methods became more critical as well. The combination of developing both more advanced superalloys and coatings, he concluded, resulted in success in harsh gas turbine environments.

The industrial gas turbine industry now faces a new set of challenges, Mason said, including higher operating temperatures, harsh environments, power generation grid instability, increasing service intervals and sustainability.

As higher operating temperatures are required, high entropy alloys and ceramic matrix composites are some of the solutions under investigation, but cost must always be considered. “The laws of economics are just as important as the laws of physics when it comes to engineering,” said Mason.

Another challenge is for gas turbines to adapt to meet power generation grid codes. At excess capacity, turbines may operate faster than they are designed to go, which could lead to fatigue, while deficient capacity could lead to creep damage. “It’s incumbent on materials engineers to understand why,” he said.



More than 600 TMS2020 attendees gathered for the plenary presentation on February 24.

It's also necessary for materials engineers to understand all damage mechanisms that might lead to early failure of equipment, because, he pointed out, customers face economic consequences when their equipment isn't running.

To illustrate the challenging environment in which gas turbines operate, he held up a blade about the size of a business card, explaining that this small blade needs to withstand heat levels comparable to that found in lava and needs to be able to hold the weight of a school bus. "Sound like a material challenge?" he asked.

The last portion of his presentation dealt with Solar Turbines' initiatives, first discussing advanced turbine alloys, including higher temperature/strength disk alloys, higher temperature/strength turbine blade alloys, and low-expansion alloys.

He then talked about advanced thermal barrier coatings (TBCs). "There's a lot of work being done in industry and academia to develop lower thermal conductivity TBCs, based upon a modified zirconia composition," he said.

Solar Turbines is currently working with a company called Solution Spray Technologies on yttrium aluminum garnet (YAG) TBCs. "It's a very, very exciting opportunity enabling higher operating temperatures," he said.

Next, he turned to additive manufacturing. "It's simply amazing what we can do today with a pile of powder and a laser," he said. "Imagine a day when we take a file in San Diego, and we print a much-needed fuel injector in Western Africa. I think that day is closer to tomorrow than next decade."

The benefits, he said, are too good to ignore, including shorter lead time and new design freedom.

"The kinds of materials that we need to print are just not inherently suitable for welding and other forming processes," he said.

Solar Turbines is already additively printing a number of parts, including fuel injector swirlers that they couldn't produce from an investment casting perspective.



Mason fields audience questions with the help of 2019 TMS President James C. Foley, who moderated the session.

Mason also talked about their Insight platform, which he referred to as Solar's version of the Internet of Things. Through this platform, they collect data from their customers' operating engines and create new digital representations, or digital twins, of the engines.



From left to right: James J. Robinson, TMS Executive Director; John Mason; Kevin Hemker, 2018 TMS President; Tom Battle, 2020 TMS President; and James Foley, 2019 TMS President, view the Titan 250, Solar Turbines' largest gas turbine engine, at the Solar Turbines booth in the TMS2020 Exhibit Hall.

"We're building these libraries of engineering models that we connected to that digital highway of actual operating data and are able to respond in real time to the changes in how that engine is being operated," he said. "The beauty of it all is that through that capability, in real time, we can resolve the damage that is accumulating on those critical, life-limited components."

This data even allows them to forecast the remaining useful life of those critical components, Mason said. "The opportunity and the potential is endless, and it's a beautiful, digital ecosystem for our materials and processes engineers and operators."

Given all of these opportunities, Mason believes gas turbine development offers a rewarding research and development environment for materials researchers.

"I think these evolving market requirements are going to drive further innovations with a very sharp focus on sustainability," said Mason. "I would say the future is bright for materials engineers and specifically, the future is bright for materials engineers who work in the turbine machinery business."

## Endnotes

1. "BP Energy Outlook: 2019 edition" (BP Energy Economics, 2019), <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/energy-outlook/bp-energy-outlook-2019.pdf>.
2. "The 35th Annual Barclays E&P Spending Survey" (Barclays, December 2019).





THE WORLD COMES HERE

# TMS

# 2020

149<sup>th</sup> Annual Meeting & Exhibition



## Keynotes and Featured Talks at TMS2020

Kelly Zappas and Ann Ritchie

More than 3,800 oral and poster presentations at 89 symposia in 15 technical tracks were delivered over the course of four days at the TMS 2020 Annual Meeting & Exhibition (TMS2020) in San Diego, California, February 23–27.

Among these were keynote sessions and invited

presentations that included daily plenaries on lead and zinc topics, special sessions on light metals and additive manufacturing, award lectures delivered by leaders in the field, and more. What follows is a look at some of these featured sessions from TMS2020.

## PbZn 2020 Plenary Sessions

The 9th International Symposium on Lead and Zinc Processing (PbZn 2020), held as a co-located event with TMS2020, featured three plenary sessions throughout the week.

The symposium opened on Monday morning with a session on the future outlook for lead and zinc. Phillip Mackey of Worley, the 2020 TMS Extraction & Processing Division Distinguished Lecturer, took listeners on a whirlwind tour, stopping at 46 lead and zinc smelters in 24 countries in the course of his presentation, “Around the Lead and Zinc Metallurgical World in Eighty Days: A Virtual Tour of World Lead and Zinc Operations and Technologies.”

The plenary series continued Tuesday morning with a look at current challenges and opportunities. Maurits Van Camp, Umicore, focused on the steps the lead industry needs to take to continue its path toward sustainability, noting that the further improvement of lead batteries is key. “We know for sure that fuel cells will be part of the future,” he said. “If

we aren’t making better batteries, we’ll lose this industry.”

PbZn 2020 held its final plenary session on Wednesday morning. Presenters from the International Lead and Zinc Study Group, the Consortium for Battery Innovation, and CHR Metals Ltd. discussed Lead and Zinc Sustainability and Social License.

PbZn 2020 was organized by TMS and co-organized by the Metallurgy & Materials Society’s Canadian Institute of Mining, Metallurgy and Petroleum; Gesellschaft der Metallurgen und Bergleute; and the Mining and Materials Processing Institute of Japan, with the Nonferrous Metals Society of China acting as a co-sponsor. Andreas Siegmund, LanMetCon LLC, served as the PbZn 2020 organizing committee chair.



Pictured are Monday’s plenary speakers with members of the PbZn 2020 Organizing Committee, from left: Stephen James, Nyrstar, speaker; Huw Roberts, CHR Metals Limited, speaker; Andreas Siegmund, LanMetCon LLC, organizing committee chair; Phillip Mackey, Worley; and Joseph Grogan, Gopher Resource.



Phillip Mackey



Maurits Van Camp

## Electrometallurgy 2020 and Sadoway 70

The 3rd International Symposium on Electrometallurgy (Electrometallurgy 2020) was also held in conjunction with TMS2020. This special symposium featured two days of sessions on hydrometallurgy, molten salts, and applications to battery or materials synthesis, followed by the symposium Process Metallurgy and Electrochemistry of Molten Salts, Liquid Metal Batteries, and Extra-Terrestrial Materials Processing: An Extraction & Processing Division Symposium in Honor of Don Sadoway (Sadoway 70).

In his keynote talk for Electrometallurgy 2020, Adam Powell of Worcester Polytechnic Institute looked at several ways that electrometallurgy can play a key role in

addressing climate-change-related issues, while exploring ties to Sadoway's work. He looked at research themes including carbon-free ironmaking and the future of energy storage, even touching on advances in electrometallurgy that could make zero or negative greenhouse gas emissions in jet fuel possible.

Luis Ortiz, LAO Consulting, opened the Sadoway 70 honorary symposium on Wednesday morning with the presentation, "Better Living through Electrochemistry: Innovation and Incrementalism," which looked at Sadoway's work in process electrometallurgy, battery energy storage, and advanced ironmaking and the role of small, gradual transitions compared to major, game-changing developments.

"I think they're complementary: innovation and incrementalism," said Ortiz of the two approaches. "Think

how incrementalism can get the ball rolling to those big innovations. Incremental improvements can help soften people up before making the big transition that comes from innovation."



Luis Ortiz



Adam Powell

## Award Lectures and Sessions at TMS2020



Ursula R. Kattner, National Institute of Standards and Technology, delivered the lecture, "Phase Diagrams, Computational Thermodynamics and CALPHAD," as the William Hume-Rothery Award lecturer.



Yuntian Zhu, North Carolina State University, delivered the Institute of Metals/Robert Franklin Mehl Award lecture on the topic, "Heterostructured Materials: A New Paradigm for Designing Metals with Superior Mechanical Properties."



Robert O. Ritchie (right), University of California, Berkeley, delivered the inaugural William D. Nix Award Lecture, "Damage Tolerance in Materials." He is pictured here with Nix (left).

Three TMS members were honored at the TMS2020 Acta Materialia Award Symposium. Pictured, from left, are award recipients and organizers: Carolyn Hansson, University of Waterloo, session organizer; Diana Lados, Worcester Polytechnic Institute, Acta Materialia Silver Medal recipient; Lynnette Madsen, National Science Foundation, Acta Materialia Hollomon Award for Materials and Society recipient; George T. "Rusty" Gray III, chair and treasurer/TMS governor, Acta Materialia; Enrique Lavernia, University of California, Irvine, Acta Materialia Gold Medal recipient; and Christopher Schuh, coordinating editor/governor, Acta Materialia.





## Light Metals Keynote Session

“As an industry, we’re competing for the bright stars of the future,” said Joe Lombard of Hatch at the 2020 Light Metals Keynote session. Lombard was one of five speakers from industry and academia, hailing from New Zealand, Canada, Norway, and the United States, to share their views on how the light metals industry can attract and grow the next generation of technical talent.

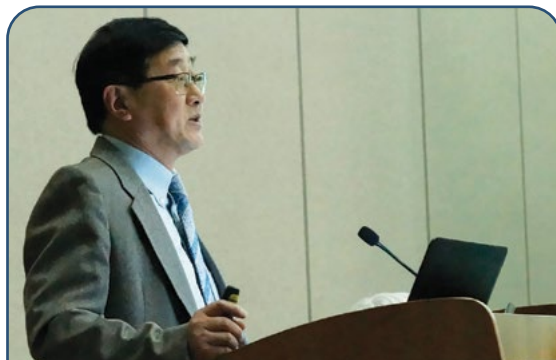
The competition begins at the college level, according to Alan Luo, The Ohio State University. “We’re a big university, accepting 800 undergraduate freshmen to engineering,” said Luo. Because materials science and engineering (MSE) is competing with other departments for students, he said, they send their best faculty to teach the introduction to MSE course, in order to get students’ attention.

Nina Dahl, SINTEF Industry, outlined some of the

research areas that are open to young people in the light metals industry in her presentation, “The Norwegian Perspective.” These included electrolysis technology, oxidation, direct chill (DC) casting of aluminum, and additive manufacturing. “Young people care about climate change and environmental issues,” she said. “This industry is part of the solution.”

In addition to discussing how best to recruit young people, the session also focused on how best to prepare them for work in the field.

“There’s no shortage of focus on technical skills,” said Margaret Hyland, University of Wellington. “We need to prepare the future workforce for adaptability and allow students to understand the context in which they work.”



Alan Luo



Pictured, left to right, are speakers Alan A. Luo, The Ohio State University; Joe H. Lombard, Hatch; Margaret Hyland, University of Wellington; Corleen Chesonis, session organizer; Nina Dahl, SINTEF Industry; and Robert B. Wagstaff, Oculatus Inc.

## Magnesium Technology Keynote Session

The popular Magnesium Technology symposium at TMS2020 opened with a session of invited talks on Monday morning, February 24. Speakers included Carlos Tome,

Los Alamos National Laboratory, who discussed “Twin Transmission across Grain Boundaries in Magnesium;” Rajiv Mishra, University of North Texas, with “Hierarchically Structured Ultrafine Grained Magnesium Alloys;” and Mark Horstmeier, Liberty University, with “MultiSage Fatigue (MSF) Modeling of Magnesium in a Corrosion Environment.”

Magnesium Technology sessions were held throughout the week on the topics of alloy design and solidification; thermomechanical processing; corrosion; and more.



Pictured, left to right, are Carlos Tome, Los Alamos National Laboratory, speaker; J. Brian Jordon, University of Alabama, organizer; Victoria Miller, University of Florida, organizer; Rajiv Mishra, University of North Texas, speaker; Mark Horstmeier, Liberty University, speaker; and Vineet Joshi, Pacific Northwest National Laboratory, organizer.



Carlos Tome

## Additive Manufacturing Joint Keynote Session

“Everything that was old at TMS is new again because of additive manufacturing,” said Douglas Hofmann, NASA Jet Propulsion Laboratory (JPL)/California Institute of Technology, during the closing presentation of the Additive Manufacturing Keynote Session at TMS2020.



Douglas Hofmann

“Metallurgy wasn’t always popular,” Hofmann said, looking back to 2008 when nanotechnology was the big thing. At the time, he worried that metallurgy was an unemployable career field, but then additive manufacturing came along.

His presentation, “Innovation in Additive Manufacturing: A Perspective on an Early Career in Metal Alloy Development,” outlined the role additive has played in his career, including giving him the opportunity to build a metallurgy lab at JPL. He also discussed some of his work in additive manufacturing, including the use of multi-material additive to eliminate bolts for spacecraft by merging two materials together.

Hofmann, who is the inaugural recipient of the TMS Young Innovator in the Materials Science of Additive Manufacturing Award, was one of four speakers at February 24’s well-attended keynote session, which brought together participants from the eight additive manufacturing symposia held throughout the week at TMS2020.

## Frontiers of Materials Symposia

Two special sessions were presented at TMS2020 as part of the inaugural TMS Frontiers of Materials Award. As part of the award, recipients Keith Brown, Boston University, and Natasha Vermaak, Lehigh University, organized symposia on hot or emerging topic areas.

Vermaak delivered the opening presentation, “Leveraging Materials in Topology Optimization,” at the symposium of the same name on Tuesday at TMS2020. Seven invited speakers discussed innovative methods and applications of design and topology optimization for materials. The session featured such unique contributors as a designer who uses 3D printing to create fashion and an architect/artist who transforms

waste items like coffee grounds and grape seeds into objects like coffee cups and wine glasses through 3D printing.

Brown’s symposium, Machine Learning and Autonomous Researchers for Materials Discovery and Design, discussed autonomous mechanics, machine learning, and autonomous researchers for materials. In his talk, “Unraveling Hierarchical Materials Using Autonomous Research Systems,” he challenged the audience to accelerate materials and structural discovery by increasing experiments using automation. “I want to thank TMS for bringing together a field that might not otherwise be at TMS,” Brown said.



Natasha Vermaak



Keith Brown



## Expanding the Boundaries of Materials Science: Unconventional Collaborations

Highlights of the latest TMS study, *Creating the Next-Generation Materials Genome Initiative Workforce*, were part of the symposium, Expanding the Boundaries of Materials Science: Unconventional Collaborations, organized by students from North Carolina State



Symposium presenters and organizers included (left to right): Benjamin Anthony, University of Florida, organizer; David McDowell, Georgia Institute of Technology, speaker; Matthew Horton, Lawrence Berkeley National Laboratory, speaker; and Sourabh Kadambi, North Carolina State University, organizer.

University and the University of Florida. David McDowell, Georgia Institute of Technology, described the study as being at the intersection of big data and materials science, stating that it could significantly impact the materials science and engineering workforce. It includes actions for workforce development that cover the key tasks, timeframes, metrics, and resources, along with additional recommendation for advanced education and training.



David McDowell

"We require a sustained community effort to reform the curricula. It's time to build out the momentum in federal agencies, professional societies, and academia," McDowell said.

Copies of the study are available for free download at [www.tms.org/Studies](http://www.tms.org/Studies).

## New for 2020: Materials and Manufacturing Innovation Luncheon

TMS piloted the Materials and Manufacturing Innovation Luncheon in 2020 to bring prominent speakers together to forecast new technologies and emerging trends in industry on Thursday, February 27. After the presentations, Charles Ward, chief of the Manufacturing and Industrial Technologies Division, U.S. Air Force Research Laboratory's Materials and Manufacturing Directorate, moderated a panel discussion.

Glenn Daehn, The Ohio State University, began with "Metamorphic Manufacturing: A New Frontier for Digital Manufacturing," where he explored new market opportunities for a technology that "forges metal objects to precise specifications" using artificial intelligence. Advanced manufacturing is entering a new wave, where manufacturing can take place quickly at "a point of need," but Daehn stressed the importance of bringing together a range of talents in materials science, information systems, computer science, and other areas. "This is a classically interdisciplinary problem," Daehn said.

Celia Merzbacher, Quantum Economic Development



Maneesh Gupta

Consortium, followed with "Materials for Quantum and Quantum for Materials," to discuss how quantum technologies are leading to novel applications, such as sensors, communications, and computing. Quantum computing has the potential to advance complex problems across many sectors, including simulations and molecular modeling, chemical processes, and fluid dynamics. She emphasized a need to understand materials in relation to device performance and described the quantum ecosystem as a "hot industry with a small market whose large and disruptive potential is spurring public and private partnerships."

Maneesh Gupta, Air Force Research Laboratory, concluded the luncheon with "Synthetic Biology: An Emerging Toolkit for Materials Manufacturing" to highlight how synthetic biology efforts by the U.S. Department of Defense could have broad applications. Gupta gave several natural examples of materials that could have industrial uses, such as the tensile strength of spider silk and the anti-reflective optics of insect eyes. "We use these examples as models for what to create and go beyond what biology has already done," Gupta said.



The Materials and Manufacturing Innovation Luncheon offered presentations from three speakers, including Glenn Daehn (pictured), and an engaging Q&A session while generating interest in technologies soon to come.





The TMS Annual Meeting & Exhibition is often referred to as a family-like gathering for the global minerals, metals, and materials science and engineering community, bringing together members from around the world to share research, work together on topics of common interest, and build lasting relationships. The following pages offer a look at some of the social and networking events that brought people together during the TMS 2020 Annual Meeting & Exhibition (TMS2020), February 23–27, in San Diego, California.

## Awards Ceremony and Banquet



Guests mingle at a reception prior to the TMS-AIME Awards Ceremony.

Nearly 50 individuals were recognized for significant achievements at all stages of their careers during the TMS-AIME Honors & Awards Ceremony and Banquet, held Wednesday, February 26. This event included presentation of awards by the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), of which TMS is a member society.

The highest honors of the evening went to the 2020 Class of TMS Fellows, recognizing the outstanding contributions of these individuals to the practice of metallurgy, materials science, and technology.



Mark Asta (left) says a few words, accepting his TMS Fellow Award. Dorte Juul Jensen (right) accepts her TMS Fellow Award from 2019 TMS President James Foley (center).

This year's Fellows included **Mark Asta**, who acknowledged TMS for playing such a central role, both in his career and in the development of integrated computational materials engineering (ICME); **Rodney Boyer**, who looked back at his career in titanium and recognized the mentors who helped him along the way; **Marc DeGraef**, who reflected on his 28 years of involvement with TMS, looking forward to the next 28; **Diana Farkas**, who talked about the lack of women in the field when she started and the importance of having role models like Julia Weertman and Millie Dresselhaus; **Dorte Juul Jensen**, who was enthusiastic about becoming a Fellow of the "best Society in the world," saying that nothing compares to TMS; **Karl Kainer**, a member of TMS's Magnesium Committee from its start, called TMS a professional family and the voice of the magnesium community; **David McDowell**, who said that, with TMS, he had the chance to work on ICME and the Materials Genome Initiative when they first took root; and **Neville Moody**, who said he's always found a home in TMS, where he's developed enduring friendships and collaborations.

"These Fellows' comments remind us of the richness of the TMS experience over the years," said presenter Elizabeth Holm, 2019 TMS Fellow, as she congratulated the new class of Fellows.



Award recipients and guests enjoyed a banquet following the awards ceremony.



## Student Events

The Colorado School of Mines “Orediggers” team successfully defended their title as champions at the 2020 TMS Materials Bowl on Sunday, February 23. They faced off against the University of Illinois “Speedy Spinels” in the final round of this day-long competition. This is the third consecutive win for the team and their eighth win overall.



2019 TMS President James C. Foley (center) presented the trophy to the winning team members (from left to right): John Copley, Cierra Dellarova, Melissa Thrun, and Chad Haunschild.

The TMS Materials Bowl, held each year at the TMS Annual Meeting, is a materials-themed knowledge and trivia competition for university students. Twelve teams, made up of undergraduate and graduate students, competed in this year’s event, which was sponsored by Goodfellow.

Later in the week, graduate and undergraduate students participated in the interactive Student Career Forum panel discussion, held on Tuesday, February 25, where they had the opportunity to learn from the career experiences of professionals working in industry, academia, and government. The experiences shared by the six panelists demonstrated that there is more than one way to build a career in materials science and engineering.



Student career forum participants, from left to right, were: Adam Hope, Thermo-Calc Software; Kester Clarke, Colorado School of Mines; Nolan Hoffman, U.S. Army Engineer Research and Development Center; Mark Horstemeyer, Liberty University; Melanie Lang, FormAlloy; and Remi Dingreville, Sandia National Laboratories.

Panelists fielded student questions, providing insight on when (and if) to go to graduate school, what it takes to create your own business, and how to recognize an opportunity when you see it, including opportunities that present themselves at a conference like TMS2020.

“Developing a network where everyone trusts you is important,” said Kester Clarke, Colorado School of Mines. “Go and meet and talk to everyone this week. These meetings are really valuable for this.”

A recording of this session is now available to view in the Recorded Presentations section of the TMS website at [www.tms.org/Recordings](http://www.tms.org/Recordings). This event is organized each year by the TMS Young Professional Committee.

## Diversity and Inclusion Events

TMS Pride of the TMS Diversity Committee kicked off the meeting week on Sunday, February 23, with its highly successful second annual LGBTQ+ and Allies Networking Mixer. Open to all TMS2020 attendees, the event provided an opportunity to share good food and conversation in a safe space as LGBTQ+ individuals and allies celebrated their common experiences and interests.



Natasha Vermaak (left), welcomed attendees to the Diversity and Inclusion Breakfast

The TMS Leadership Development Initiative—a new program being developed by the Race and Ethnicity Working Group of the Diversity Committee—launched its pilot phase on Monday, February 24. The Initiative focuses on preparing and supporting TMS members from underrepresented ethnic minority groups in their pursuit of leadership roles and active engagement within TMS. Once the pilot phase has been concluded and evaluated, the program will be formally rolled out to TMS membership.

Concluding the week was the Fresh Coffee, Fresh Ideas: Diversity and Inclusion Breakfast, a well-established feature of the TMS Annual Meeting. Natasha Vermaak, chair of the Diversity Committee, welcomed attendees and then encouraged participants at each table to discuss an assigned topic, switching tables after 15 minutes to discuss a new topic related to diversity and inclusion issues.

## Young Professional Tutorial Luncheon

Early Career Faculty Fellows Jessica Krogstad, University of Illinois at Urbana-Champaign, and C. Cem Tasan, Massachusetts Institute of Technology, spoke at the Young Professionals Tutorial Luncheon and Lecture on Tuesday, February 25.

Krogstad presented “Challenging the Paradigm for Materials in Extreme Environments,” where she discussed how the evolution of material properties in service is as important as initial properties. She encouraged materials scientists to further modernization of processing-property relationships by expecting change in the service of materials. “Deliberately dynamic materials would improve in extreme environments instead of degrading,” Krogstad said.



C. Cem Tasan (left) and Jessica Krogstad (right) speak at the Young Professionals Tutorial Luncheon and Lecture.



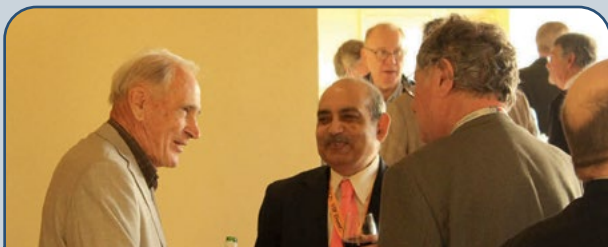
Guests attending the Young Professionals Tutorial Luncheon and Lecture.

Tasan spoke on refractory high-entropy alloys (rHEA) and asked, “What can mixing thermodynamics do for rHEA?” He returned to this question that lies at the core of the high-entropy alloy field to improve upon rHEA and explore how it results in good property combinations.

Both lecturers also gave career advice that underscored the importance of communication skills and networking, along with good work. Krogstad pushed her listeners to pursue great ideas, especially when they challenge the norm. “That’s the advantage of being young and in the materials science field, right? Keep thinking big,” she said. Tasan stressed the importance of diligence along the road to career success, but he also asked listeners to value occasional surprises and unexpected revelations. “Rely on a little randomness and make observations. Whatever path you are following, it takes a lot of work,” he said.

## Networking Receptions

Throughout the week, attendees had a number of opportunities to connect with old friends and meet new colleagues at social and networking events. Find more photos on Flickr at [www.flickr.com/photos/tmsevents/](http://www.flickr.com/photos/tmsevents/).



TMS members re-connected with colleagues at the TMS Fellows and Invited Guests Reception



Student attendees gathered on Sunday, February 23, for the Student Networking Mixer.



An opening reception, happy hour, poster sessions, and daily lunches brought attendees together in the TMS2020 Exhibit Hall.



## Division Luncheons

The Structural Materials Division (SMD), Extraction & Processing Division (EPD), Materials Processing & Manufacturing Division (MPMD), and Light Metals Division (LMD) of TMS held luncheons featuring invited lectures and award presentations at TMS2020. The Functional Materials Division (FMD) award recipients were recognized at the FMD council meeting. Awards photos can be found on Flickr at [www.flickr.com/photos/tmsevents](http://www.flickr.com/photos/tmsevents).

### SMD Luncheon



Ricardo Lebensohn

Ricardo Lebensohn, Los Alamos National Laboratory, discussed "How Modelers Are Keeping up with Emerging Materials Characterization and Data Analytics Techniques" as the featured speaker at the SMD Luncheon on Monday, February 24.

Lebensohn looked at emerging methods in experimental mechanics and material characterization and at how we collect data. "All of this is enabled by increasing computing power," he said. "All of it is impacted by doing computations in a rapid fashion." We collect data and create models, he went on, but need to emphasize the connections between methods and models.

In some cases, he pointed out, we don't need machine learning; what we need is subject matter expertise. He closed his presentation by offering two examples of when machine learning is valuable and when subject matter expertise is more useful.

### EPD/MPMD/PbZn Luncheon

Markus Reuter of the Helmholtz Institute Freiberg for Resource Technology addressed guests at the EPD/MPMD/PbZn 2020 Luncheon on Tuesday afternoon as the event's featured speaker. Reuter's talk, "Process Metallurgy as a Key Enabler of the Circular Economy: Digital Twinning of the Resource and Processing System," discussed the key role of metals in the circular economy.

While the general public often wants to do away with metals like lead or zinc completely, he said, taking any metal out of the system will make it collapse. Showing the image of a wheel, he explained, "If you take any section out, the wheel doesn't turn."

His talk included a discussion of how the public perceives the role of metals in society and how we can help promote a more accurate message about our field. "It's a beautiful field to be in," said Reuter.



Markus Reuter (top)

### LMD Luncheon



Grant Pattinson

When you use a microscope, if you start by using the small knob, or fine focus, you likely won't get where you want to be. To get to the right place as quickly as possible, "use the big knob first," said Grant Pattinson in his presentation as the TMS Light Metals Division Luncheon lecturer on Wednesday, February 26.

Pattinson, who is manager of Tesla's Materials Engineering Metals and Ceramics team, shared examples of how this philosophy plays out in the development of materials and castings for Tesla.

"What sets us apart is, when we're doing design selection, we design specially produced materials," said Pattinson. "We don't necessarily use what is readily available."

Because they need to produce a large volume of parts per day for their products, timing is key. "Additive, for what we're doing, isn't fast enough," he said, before discussing the benefits and limits of high-pressure and low-pressure casting.

Samantha Schloder, recipient of the 2020 LMD Scholarship, also addressed luncheon attendees, sharing her experiences as a materials science/engineering student at the University of Pittsburgh and during a co-op experience at Constellium in Ravenswood, West Virginia.



Posters by undergraduate and graduate students were honored for excellence at the 2020 Technical Division Student Poster Competition, held at the TMS 2020 Annual Meeting & Exhibition (TMS2020) in San Diego, California,

February 23–27. A number of TMS2020 symposia also recognized quality work through poster and presentation competitions. Congratulations to all of the award recipients who are recognized on the following pages.

## Technical Division Student Poster Competition Winners

### Extraction & Processing Division (EPD) Award

**Graduate:** “An X-ray Spectromicroscopy Study of the Calcium Mineralization in the JEB Tailings Management Facility at McClean Lake, Saskatchewan,” Arthur Situm, University of Saskatchewan

### Functional Materials Division (FMD) Awards

**Graduate:** “Healable Transparent Supramolecular Polymer Nanocomposites-based Energy Storage Device for Wearables and Robotics,” Gurunathan Thangavel, Nanyang Technological University

**Undergraduate:** “Development of an All Solid-state Printed Carbon Electrode Utilizing Nickel Oxide/oxyhydroxide for Phosphate Detection,” Sookyoung Jeong, Purdue University

### Light Metals Division (LMD) Awards

**Graduate:** “Effects of Mg and Si Additions to Novel Al-Ce base Alloys for Aerospace Applications,” Manny de Jesus-Lopez, University of Puerto Rico, Mayaguez

**Undergraduate:** “Effects of Mg+Si Additions on the Microstructure and Mechanical Properties of Al-Ce-Sr based Alloys,” Ramon Padin, University of Puerto Rico, Mayaguez

### Materials Processing & Manufacturing Division (MPMD) Awards

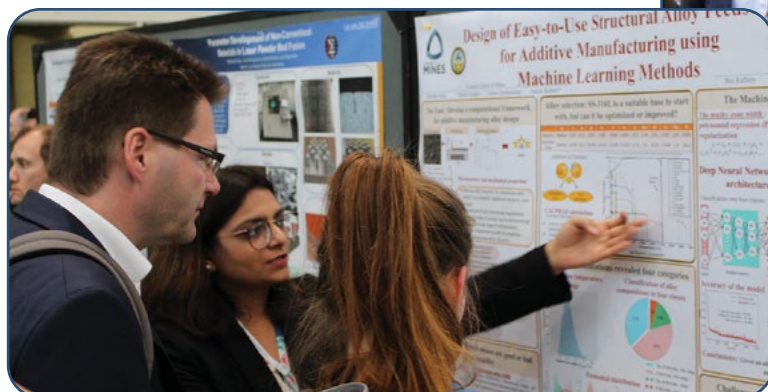
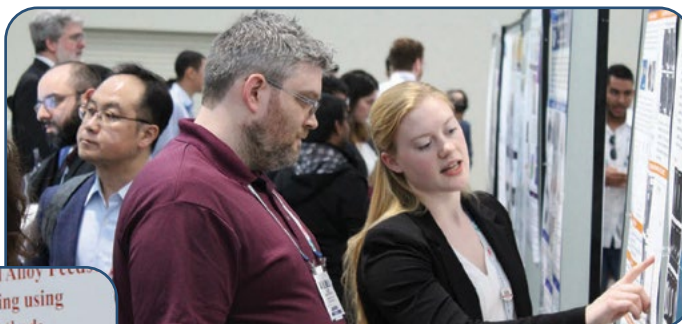
**Graduate:** “Modeling and Predicting Longitudinal Defect Mechanisms in Steel Continuous Casting,” Matthew Zappulla, Colorado School of Mines

**Undergraduate:** “Overcoming Oxidation of CMSX-4 to Determine the Thermophysical Properties in the Liquid State,” Zane Smith, Purdue University

### Structural Materials Division (SMD) Awards

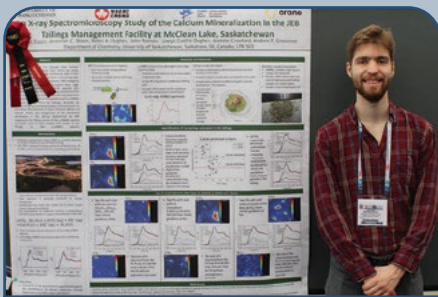
**Graduate:** “Deformation Mechanisms in Imm-Ni<sub>2</sub>(Cr,Mo,W)-containing Haynes® 244® Superalloy,” Thomas Mann, Purdue University

**Undergraduate:** “Computational Indicators of Ductility in Compositionally-complex B2 Alloys,” Emily Hwang, Harvey Mudd College

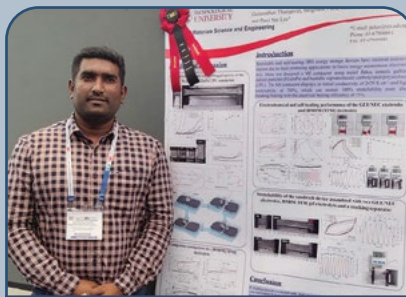




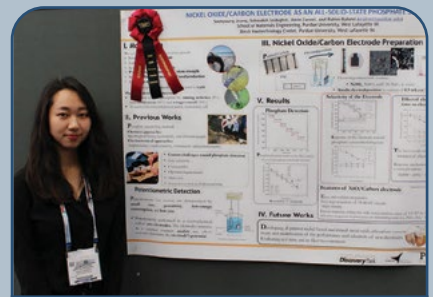
## Technical Division Student Poster Competition Winners



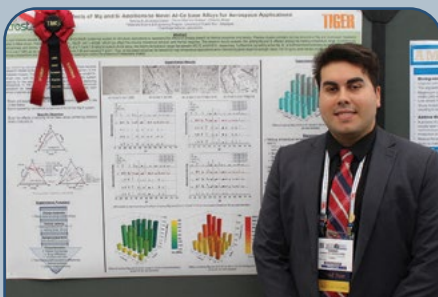
Arthur Situm,  
University of Saskatchewan



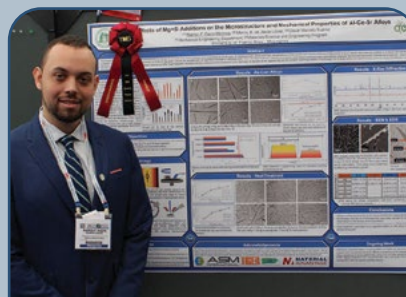
Gurunathan Thangavel,  
Nanyang Technological University



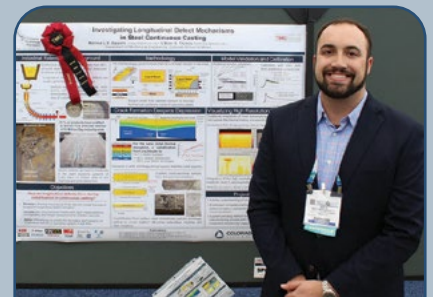
Sookyoung Jeong,  
Purdue University



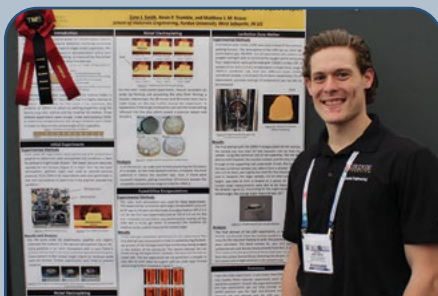
Manny de Jesus-Lopez,  
University of Puerto Rico, Mayaguez



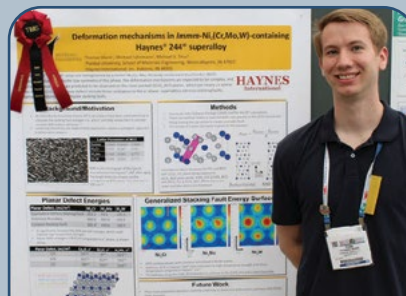
Ramon Padin,  
University of Puerto Rico, Mayaguez



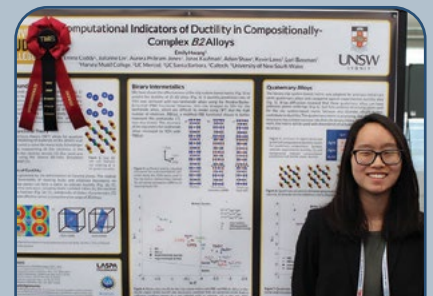
Matthew Zappulla,  
Colorado School of Mines



Zane Smith,  
Purdue University



Thomas Mann,  
Purdue University



Emily Hwang,  
Harvey Mudd College

## Advanced Real Time Imaging Symposium Awards

**First-Place Oral Presentation:** “New Biomarkers of Prostate and Breast Cancer Metastasis to Bone,” *Kalpana Katti*, Sumanta Kar, Haneesh Jasuja, M.D. Shahjahan Molla, and Dinesh Katti, North Dakota State University

**Second-Place Oral Presentation:** “X-ray Phase Contrast Imaging of Dynamic Compression of Additively Manufactured High-solids-loaded Polymer Composites,” Karla Wagner, Andrew Boddorff, Greg Kennedy, Min Zhou, and Naresh Thadhani, Georgia Institute of Technology

### Third-Place Oral Presentation (Tie):

“In-situ Observation of Hyperbranched Dendrite Growth,” *Tiberiu Stan*, Kate Elder, and Peter Voorhees, Northwestern University; Xianghui Xiao, Brookhaven National Laboratory

“Micro-scale Imaging of Cancerous Tissues using High Frequency Ultrasound,” Leila Ladani and Koushik Paul, Arizona State University

**First-Place Oral Presentation, Student:** “HT-LSCM as a Tool for Indirect Determination of Precipitates by Real Time Grain Growth Observations,” *Nora Fuchs*, Christian Bernhard, and Susanne Michelic, University of Leoben; Rian Dippenaar, University of Wollongong

**Second-Place Oral Presentation, Student (Tie):**

“Inkjet Printed Electrochemical Aptasensor for Detection of  $\text{Hg}^{2+}$  in Organic Solvents,” *Lixby Diaz-Amaya*, Li-Kai Lin, Renee DiNino, and Lia Stanciu, Purdue University; Carlos Ostos, Universidad de Antioquia

“ $\text{Sc}_3\text{N@C}_{80}$  and  $\text{La@C}_{82}$  doped Graphene Photodetectors,” *Kishan Jayanand*, Ravindra Mehta, Srishti Chugh, and Anupama Kaul, University of North Texas

**First-Place Manuscript/Conference Proceedings:**

“Development of HT-LSCM Techniques for the In-situ Study of the Peritectic Phase Transition,” Rian Dippenaar, Dominic Phelan, Mark Reid, Suk-Chun Moon, and Dasith Liyanage, University of Wollongong; Stefan Griesser, Inteco

## Alloys and Compounds for Thermoelectric and Solar Cell Applications VIII Symposium Best Posters

**First-Place Poster:** “Realizing the Microstructure in GeTe-based Thermoelectric Materials and Phase Transition Behavior,” *Yi Fen Tsai* and Hsin-Jay Wu, National Chiao-Tung University; Pai-Chun Wei, King Abdullah University of Science and Technology

**Second-Place Poster:** “Thermoelectric Properties of Multiply Doped  $\text{Mg}_3(\text{Sb}, \text{Bi})_2$ ,” *Yasuo Shibata*, Yuji Ohishi, and Hiroaki Muta, Osaka University

**Third-Place Poster:** “Assessment of Co-P Diffusion Barrier for Bismuth Telluride-based Thermoelectric Materials,” *Zhen-Wei Sun*, Chun-Hsien Wang, and Albert T. Wu, National Central University

**Second-Place Manuscript/Conference**

**Proceedings:** “Sub-rapid Solidification Study of Silicon Steel by Using Dip Test Technique,” Hairui Qian and Wanlin Wang, Central South University

**Third-Place Manuscript/Conference Proceedings:**

“Real-Time Imaging of the Melting and Crystallization of Synthetic Ferronickel Slags with Varying  $\text{B}_2\text{O}_3$  Content,” Shifan Dai, Wanlin Wang, Lejun Zhou, Tongsheng Zhang, and Jie Yu, Central South University



The winners and judges for the Alloys and Compounds for Thermoelectric and Solar Cell Applications Symposium best poster competition are, from left to right: Albert Wu (judge), H. J. Wu (judge), Yasuo Shibata, Yi-Fen Tsai, Zhen-Wei Sun, and George Nolas (judge).

## Biodegradable Materials for Medical Applications II Best Posters

**First-Place Poster:** “Novel Method for Increasing Mechanical Properties of Biodegradable Zinc,” *Anna Jarzebska*, Magdalena Bieda-Niemiec, Łukasz Maj, Martyna Strąg, Robert Chulist, Jan Guśpiel, and Krzysztof Sztwiertnia, Institute of Metallurgy and Materials Science, Polish Academy of Sciences, Krakó; Daniel Wojtas, AGH University of Science and Technology Faculty of Physics and Applied Computer Science; and Waław Pachla, Institute of High Pressure Physics, Polish Academy of Sciences, Warszawa

**First-Place Poster, Student:** “Research on Zn-Ag-Mg Alloy as a Potential Biodegradable Implant Material,” *Maria Watroba*, Wiktor Bednarczyk, Jakub Kawalko, Krzysztof Mech, and Piotr Bała, AGH University of Science and Technology; and Gabriela Boelter and Manuel Banzhaf, University of Birmingham

**Second-Place Poster, Student:** “Long Term Inflammatory Response to Zinc Materials in Murine Arteries,” *Alexander Oliver*, Roger Guillory, Timothy Kolesar, Lea Morath, Katie Flom, Ehsan Mostaed, Jaroslaw Drelich, and Jeremy Goldman, Michigan Technological University

**Third-Place Poster, Student:** “Discovery of Alloying Elements and Processing Parameters that Impart Improved Biocompatibility of Zinc-based Medical Implants,” *Lea Morath*, Alexander Oliver, Katie Flom, Roger Guillory, Jeremy Goldman, Eshan Mostaed, and Jaroslaw Drelich, Michigan Technological University

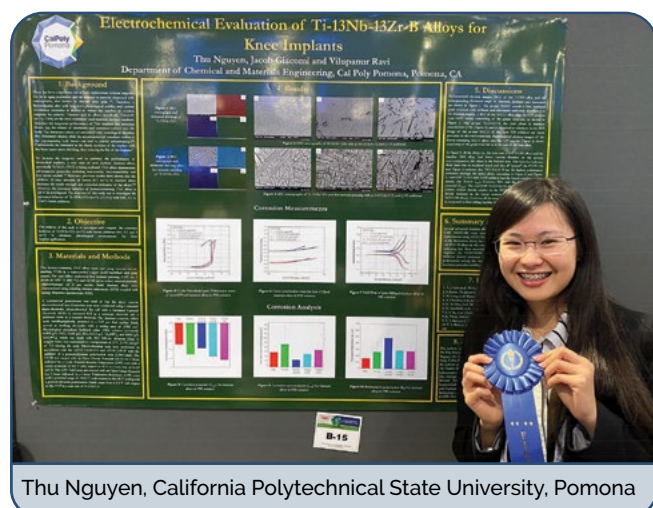


## Biological Materials Science Symposium Best Posters

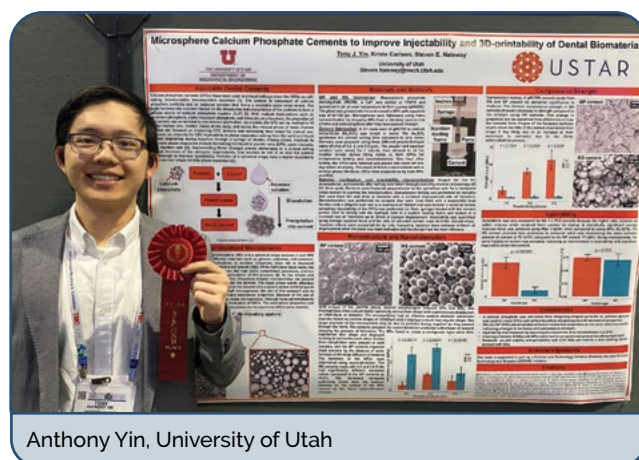
**First-Place Poster:** “Electrochemical Evaluation of Ti-13Nb-13Zr-B Alloys for Knee Implants,” *Thu Nguyen*, Jacob Giacomi, and Vilupanur Ravi, California Polytechnical State University, Pomona

**Second-Place Poster:** “Microsphere Calcium Phosphate Cements to Improve Injectability and 3D-printability of Dental Biomaterials,” *Anthony Yin*, Krista Carlson, and Steven Naleway, University of Utah

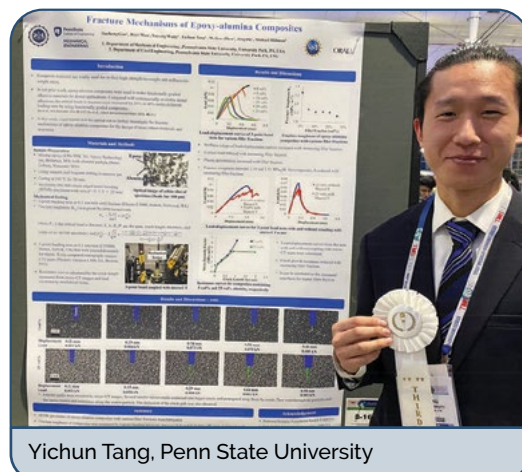
**Third-Place Poster:** “Fracture Mechanisms of Epoxy-alumina Composites,” Jiacheng Gao, Ruyi Man, Yuyang Wang, *Yichun Tang*, Kangning Su, Michael Hillman, and Jing Du, Penn State University



Thu Nguyen, California Polytechnical State University, Pomona



Anthony Yin, University of Utah



Yichun Tang, Penn State University

## Fatigue in Materials: Fundamentals, Multiscale Characterizations and Computational Modeling Symposium Best Posters

**First-Place Poster:** “Deformation Mechanism of Nickel-titanium-hafnium Alloys Subjected to Rolling Contact Fatigue Experiments,” Behnam Aminahmadi, *Sean Mills*, and Aaron Stebner, Colorado School of Mines; and Christopher Dellacorte and Ronald Noebe, NASA Glenn Research Center

**Second-Place Poster:** “Elucidating the Effect of High-Altitude Environments on the Fatigue Life of 7075-T651 Aluminum Alloy Determined by using AFGROW Modeling,” *Luke Brown*, University of Virginia

**Third-Place Poster:** “Effect of Machining and Surface Microstructure in Fatigue Life for Aerospace Titanium Alloys,” *Daniel Suárez Fernández*, Bradley Wynne, and Martin Jackson, The University of Sheffield; Pete Crawforth, Advanced Manufacturing Research Centre; and Katharine Fox, Rolls-Royce plc

## Phase Stability, Phase Transformations, and Reactive Phase Formation in Electronic Materials XIX

**First-Place Poster:** “From Electric Current-induced Lattice Strain to Electromigration Occurrence: An In-situ Study,” *Kuan-Hsueh Lin*, Yu-chen Liu, and Shih-kang Lin, National Cheng Kung University; and Ching-Shun Ku and Shang-Jui Chiu, National Synchrotron Radiation Research Center

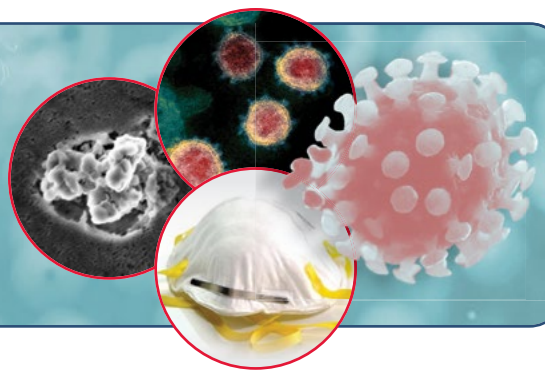
**Second-Place Poster:** “Mechanisms of Abnormal Grain Growth of Al Bonding Wires under Annealing Process,” *Jen-Hsuan Tsai* and Fan-Yi Ouyang, National Tsing Hua University

**Third-Place Poster:** “Interfacial Reactions of Ag-Au-xPd Alloys Wire Bonding with Al,” *Chiao-Yi Yang*, Kuo-Jung Chen, and Yee-Wen Yen, National Taiwan University of Science and Technology; and Wallace Chuang and Eckart Schellkes, Robert Bosch Taiwan Co. Ltd. Automotive Electronics Division



# The Materials Genome and COVID-19 Pandemic

Oladele A. Ogunseitan



Oladele A. Ogunseitan

*“The current COVID-19 pandemic period seems to be the exact pivot point for what has been learned through the MGI to address human wellbeing and environmental sustainability.”*

**—Oladele A. Ogunseitan**

## The Materials Challenge

Near the peak of the COVID-19 outbreak in Wuhan, China, the city generated about 240 metric tons of medical waste per day, nearly six-fold more than before the pandemic, thereby creating the need for flexible and repurposed mobile treatment facilities for managing solid and hazardous waste.<sup>1</sup> In the United States, the shortage of personal protective equipment (PPE), including face masks, gloves, and medical gowns, has added an unforeseen dimension to the population health crisis and unprecedented urgent requests for domestic and international donations to clinics and hospitals. It is unclear if the existing solid waste management facilities for medical waste can meet the rapid increase in demand, and there is an immediate threat that the pandemic impacts will spill over into a crisis of environmental pollution.<sup>2</sup>

Beyond medical facilities, the social distancing policies implemented in response to the pandemic have led to a dramatic surge in demand for face masks and tissue paper throughout the general population.<sup>3</sup> The gap between demand and supply of such products has led to urgent calls for strategies to collect, disinfect, recycle, and reuse masks.<sup>4</sup>

However, there are serious potential risks of infection associated with the reuse of face masks because of the wide range of materials, filtration capacity, and life expectancy of masks designed to protect against exposure to virus particles.<sup>5,6</sup> After the last pandemic flu episode, there were

a lot of calls for research to define the parameters for reusing masks, but progress has been slow, probably because of limited research funding after the impact of the pandemic flu abated. Specifically, the U.S. National Academies of Sciences, Engineering, and Medicine (NASEM) issued a report on the reusability of facemasks during an Influenza pandemic, and the report’s authors advocated for more research.<sup>7</sup>

## Lessons from the MGI

The current demand for environmentally sustainable face masks is unprecedented, and it seems to have caught the U.S. manufacturing enterprise by surprise, despite considerable federal investments over the past five years in the Materials Genome Initiative (MGI).<sup>8,9</sup> As a multi-agency initiative, the MGI was designed to support efforts to quickly and affordably “discover, manufacture, and deploy” advanced materials that are critical for economic security and human wellbeing.<sup>10</sup>

The current COVID-19 pandemic period seems to be the exact pivot point for what has been learned through the MGI to address human wellbeing and environmental sustainability. Instead, the federal government invoked the Defense Production Act to compel manufacturers such as 3M to expedite the production of traditional PPE and to restrict exportation to other countries.<sup>11</sup> Simultaneously, the U.S. Environmental Protection Agency

## Do You Have a Perspective to Share?

*JOM*: The Magazine is seeking case studies, member perspectives, and non-technical project overviews with strong industrial applications. To suggest an article idea, contact Kaitlin Calva, *JOM* Magazine Managing Editor, at [kcalva@tms.org](mailto:kcalva@tms.org).



issued a temporary policy regarding enforcement of environmental legal obligations during the COVID-19 pandemic, a move that could enlarge the already considerable loopholes in hazardous waste management and materials recycling and reuse.<sup>12</sup>

### A Materials Solution?

Protocols currently being explored for reusing face masks include microwave steaming, ultraviolet radiation, and autoclaving; all have serious limitations and uncertainty of their outcomes. Real-time disinfection of PPE is an ideal solution for the challenge of extending its useful lifetime. The idea is not new, but commercial production has not been viable. We now have the opportunity to re-think investments in research on “green” materials that have intrinsic disinfection properties, are long-wearing, and are recyclable. Such materials will save the lives of front-line emergency responders and hospital-based healthcare professionals, while also contributing to the desire to flatten the curve of epidemics when used in concert with policies such as social distancing.

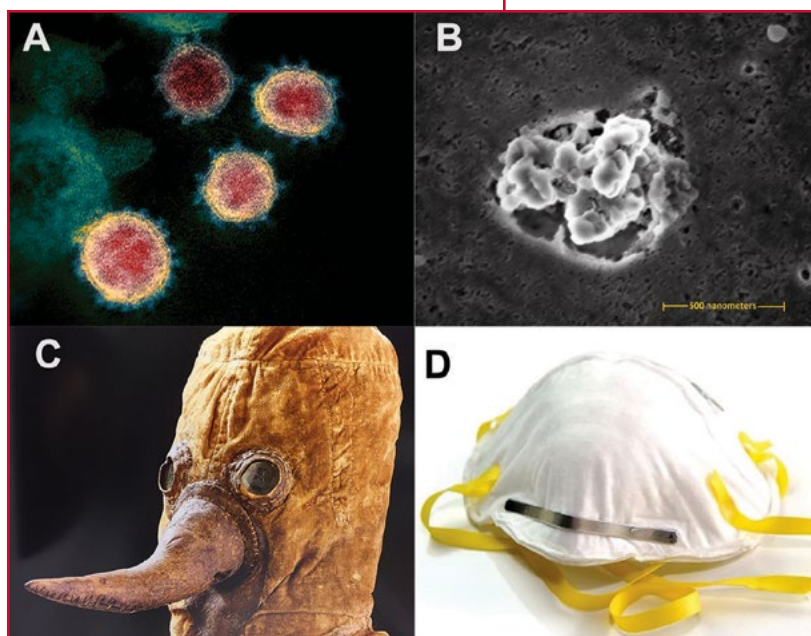
Research and development of nanotechnology-based products brought new prospects for in-use material disinfection. The research on nanomaterials has produced several commercial products, although concerns have been raised about the environmental impacts of nanoparticles released from consumer products embedded with, for example, nanosilver.<sup>13</sup> Results from a study of face masks embedded with nanosilver particles showed that 100 ppm colloidal silver produced antibacterial activity.<sup>14</sup> The limitations of research results so far accumulated are that the studies are usually based on surrogate pathogens, especially bacteria such as laboratory strains of *Escherichia coli*. Very few studies of the disinfecting properties of nanoparticles have been conducted with pathogenic viruses, in part because many such viruses are also sized in the nanometer dimension, and the physical dimensions may reduce the effectiveness of nanosized chemicals embedded in materials that must also have filter-and-hold properties.<sup>15</sup>

The proliferation of medical application

of nanosilver has provoked calls for international regulation bases on potential environmental risks associated with their toxicity and discharges in wastewater.<sup>16</sup> However, the concerns about environmental pollution may dissipate with intentional design to make nanoparticle-enhanced PPE that can last longer and is recyclable, thereby reducing the generation of solid waste that requires special management due to risks of infection.

### The Icon of a Pandemic

The beaked leather mask is a well-recognized icon of 17th century doctors wearing PPE in response to the epidemic of bubonic plague. In October 1918, during the peak of the pandemic flu that killed millions of people, the city of San Francisco, California, enacted the influenza mask ordinance that required



**Figure 1.**

**Panel A:** Transmission electron microscope image of SARS-CoV-2, the causative agent of COVID-19 pandemic. Each virus particle is approximately 125 nanometers. (Image courtesy of the National Institute for Allergies and Infectious Diseases-RML.)

**Panel B:** Scanning electron micrograph showing a cluster of silver nanoparticles with antimicrobial properties that can be embedded in PPE. The diameter of the cluster is about the size of a typical bacterium (~900 nanometers). (Image courtesy of the National Institute of Standards and Technology.)

**Panel C:** Plague doctors' face masks of the 17th century were made with naturally occurring materials such as leather, cloth, and glass. (Image courtesy of the Minneapolis Institute of Art from original display in Deutsches Historisches Museum.)

**Panel D:** Modern N95 face mask typically made of synthetic polypropylene fabric. (Image courtesy of the U.S. Food and Drug Administration.)

the population to wear face masks as a prevention strategy. The ordinance led to popular experimentations with all kinds of mask materials.<sup>17</sup>

When the COVID-19 pandemic recedes, there will be several candidate icons to mark the calamity. There is an inkling of hope that the Materials Genome Initiative will produce a candidate icon recognized by advanced sustainable materials for protective masks for the population and PPE for health professionals.

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# TMS meeting headlines

Meeting dates and locations are current as of April 3.

For the most up-to-date list of TMS-sponsored events, visit [www.tms.org/Meetings](http://www.tms.org/Meetings).

## Other Meetings of Note

**Offshore Technology Conference (OTC) Asia**  
August 17–19, 2020  
Kuala Lumpur, Malaysia

**The 6th World Congress on Integrated Computational Materials Engineering (ICME 2021)**  
April 18–22, 2021  
Lake Tahoe, Nevada, USA

**Additive Manufacturing Benchmarks (AM-Bench 2021)**  
July 12–15, 2021  
Bethesda, Maryland, USA

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

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

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



**September 13–17, 2020**  
**Seven Springs Mountain Resort**  
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**August 13, 2020**

[www.tms.org/Superalloys2020](http://www.tms.org/Superalloys2020)

- Christian Dumont of Aubert & Duval and Arnaud Longuet of SAFRAN Aircraft Engines will deliver the opening keynote.
- Purchase tickets for a tour of Fallingwater, a Frank Lloyd Wright-designed home, through the registration form. The tour will take place on Tuesday, September 15.
- Register and book your room now for the best rates! Seven Spring Mountain Resort's rates include lodging, daily breakfast buffet, Symposium Awards Reception, and daily dinner.



**October 4–8, 2020**  
**David L. Lawrence Convention Center**  
**Pittsburgh, Pennsylvania, USA**  
[www.matscitech.org/MST20](http://www.matscitech.org/MST20)

- Materials Science & Technology 2020 (MS&T20) will convene professionals from virtually every field of materials science, from metals and polymers to ceramics and composites to emerging areas like artificial intelligence. Visit the Technical Program section of the website to see all topics and symposia.
- Make travel plans and continue the tradition of this long-standing meeting, organized by a joint partnership of leading materials science-related societies: the American Ceramic Society (ACerS), the Association for Iron and Steel Technology (AIST), and TMS.

## TMS2021

150<sup>th</sup> Annual Meeting & Exhibition

**March 14–18, 2021**  
**Orlando World Center Marriott**  
**Orlando, Florida, USA**  
**Abstract Deadline: July 1, 2020**  
[www.tms.org/TMS2021](http://www.tms.org/TMS2021)

- Submit an abstract for the opportunity to share your work. Visit the Programming section of the TMS 2021 Annual Meeting & Exhibition (TMS2021) website for a full list of symposium plans.
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# call for papers

**JOM is seeking contributions on the following topics for 2020 and 2021. For the full Editorial Calendar, along with author instructions, visit [www.tms.org/EditorialCalendar](http://www.tms.org/EditorialCalendar).**



## December 2020

### Manuscript Deadline: July 1, 2020

#### Topic: Additive Manufacturing for Energy Applications (By Invitation Only)

**Scope:** This invited topic will feature manuscripts based on experimental and computational approaches including the following topic areas: Processing-microstructure-property relationship of AM fabricated materials for structural components in energy sectors; in-situ sensor development and in-situ processing and characterization; advances in AM design methodologies, new material designs and AM techniques; modeling and simulations for design of high-performance AM fabricated materials. Only papers presented at the Additive Manufacturing for Energy Applications II symposium at the TMS 2020 Annual Meeting & Exhibition will be considered for this topic.

**Editor:** Isabella van Rooyen

**Sponsors:** Additive Manufacturing Committee and Nuclear Materials Committee

#### Topic: Advances in Surface Engineering

**Scope:** This special topic aims to capture recent advances in processing, characterization, simulation/modeling, and applications related to surface engineering of materials. Areas of interest include surface protection from wear and corrosion, surface characterization techniques, surface alloying, and nanostructured surfaces.

**Editors:** Tushar Borkar, Rajeev Kumar Gupta, Sandip Harimkar, and Arif Mubarak

**Sponsor:** Surface Engineering Committee

#### Topic: Augmenting Physics-based Models in ICME with Machine Learning and Uncertainty Quantification

**Scope:** This topic will include papers on modeling complex material behavior and failure characteristics at multiple scales, using ICME and physics-based simulation tools augmented by machine learning and uncertainty quantification. Machine learning using datasets from

experiments and validated simulation tools can unravel novel material models and physical phenomena. It is necessary to couple these predictions with uncertainty quantification to understand levels of error and ways to mitigate uncertainty.

**Editors:** Somnath Ghosh, David McDowell, and James Saal

**Sponsor:** ICME Committee

#### Topic: Graphene-based Composite Materials and Applications

**Scope:** Graphene-based composite materials consist of an inorganic host solid, graphene, that is coupled with an assortment of one or more dissimilar materials. The beauty of the composite materials lies within the multifunctionality rendered by the novel design structures that often have improved properties that are not available in the original component materials. Manuscripts on recent developments of all aspects of preparation, characterization, and novel applications of advanced graphene-based composite materials are invited.

**Editor:** Simona Hunyadi Murph

**Sponsor:** Composite Materials Committee

#### Topic: Machine Learning and Other Emergent Paradigms in Computational Materials Research

**Scope:** Computational materials science has been applying essential concepts of machine learning such as guessing and iteratively optimizing solutions, interpolating functions in high-dimensional space, and manipulating patterns in data, since its inception. Recent developments in learning theory and practice, along with the proliferation of data and cheap computing, have resulted in other promising new methods and enhanced embodiments of established techniques. This special topic features papers presented at the Computational Thermodynamics and Kinetics Symposium during the TMS 2020 Annual Meeting & Exhibition.

**Editors:** Jorge A. Muñoz, Sara Kadkhodaei, and James R. Morris

**Sponsor:** Invited



**Topic: Mesoscale Materials Science**

**Scope:** This topic invites contributions in the area of advanced characterization techniques and computational approaches for understanding the nucleation and evolution of mesoscopic structures in varied class of materials.

**Editors:** Saurabh Puri and Amit Pandey

**Sponsor:** Invited

**January 2021**

**Manuscript Deadline: August 1, 2020**

**Topic: Recent Advances in Functional Materials and 2D/3D Processing for Sensors and Electronic Applications**

**Scope:** Additive manufacturing and direct-write printed electronics technologies employing metal, dielectric, polymer, and ceramic materials have the potential to enable new products and markets. This special topic will highlight emerging concepts for the processing of nanomaterials and custom 2D/3D structures. Invited and contributed papers will discuss advances in material synthesis and process technology. Topics related to functional materials, low-temperature processing, large area manufacturing, and electronic applications are within the scope of the focus issue.

**Editors:** Pooran Joshi, Nuggehalli M. Ravindra, Kostas Sierros, Tolga Aytug, and Sufian Abedrabbo

**Sponsor:** Thin Films and Interfaces Committee

**February 2021**

**Manuscript Deadline: September 1, 2020**

**Topic: Advanced Coating and Thin Film Materials for Energy, Aerospace and Biological Applications**

**Scope:** This special topic explores recent developments in advanced thin film and coating materials for energy, aerospace, and biological applications. Of particular interest are the following topics: novel coating and thin film materials and fabrication techniques, e.g., nanostructured coatings, functionally graded coatings; coating materials for energy production and energy conversion, e.g., thermal barrier coatings, coatings for solar cells, thin film materials for battery, environmental barrier coating, bio-inspired coating, and self-healing coating; and surfaces and coatings for biological and biomedical applications.

**Editors:** Jing Zhang, Yeon-Gil Jung, Albert Feuerstein, Li Li, and Raymond Sinatra

**Sponsors:** Surface Engineering Committee and Thin Films and Interfaces Committee

**Topic: Characterization of Additive Manufactured Materials**

**Scope:** The field of additive manufacturing (AM), also referred to as 3D printing, has made great progress over the past few years. Significant research is being conducted in academe and in industry, opening new application areas,

especially for rapid, custom manufacturing. Advances are being made in the development and production of certified feed powder materials, and new analytical techniques capable of characterizing end-use products. These advances are projected to yield superior, and custom end-products.

**Editors:** Rajiv Soman, Yunus Eren Kalay, and Zhiwei Peng

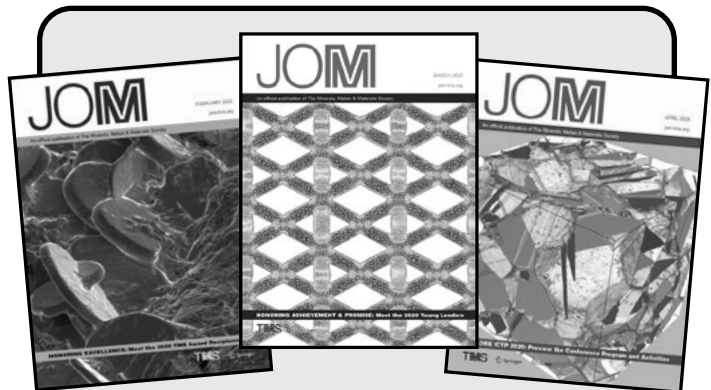
**Sponsor:** Materials Characterization Committee

**Topic: Microstructure Characterization: Descriptors, Data-Intensive Techniques, and Uncertainty Quantification**

**Scope:** Advancements in computational processing power, instrument and detector capabilities, and multi-scale modeling techniques are generating increasingly large three-dimensional microstructural datasets that have facilitated the discovery of quantitative descriptors linking processing parameters to material properties. This special topic will focus on theoretical and computational developments of novel descriptors to characterize microstructural features. Also invited are papers that apply advanced statistical techniques, such as machine learning and uncertainty quantification, for collecting, analyzing and reconstructing experimental microstructural datasets.

**Editors:** Srikanth Patala, Shawn Coleman, Jacob Bair, and Houlong Zhuang

**Sponsors:** Materials Characterization Committee, Computational Materials Science and Engineering Committee, and ICME Committee

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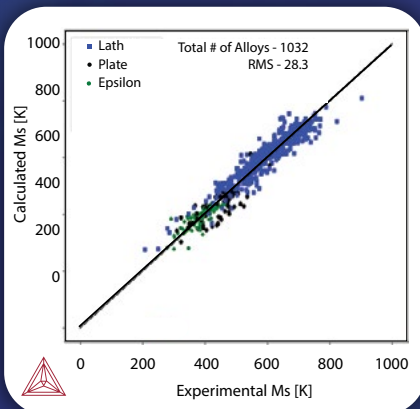
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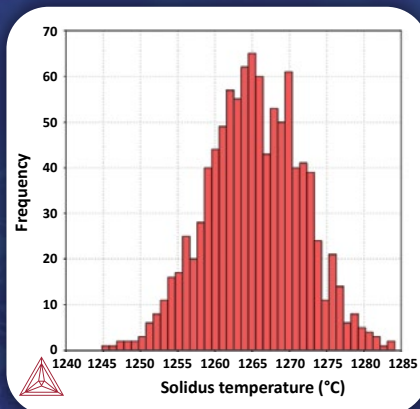
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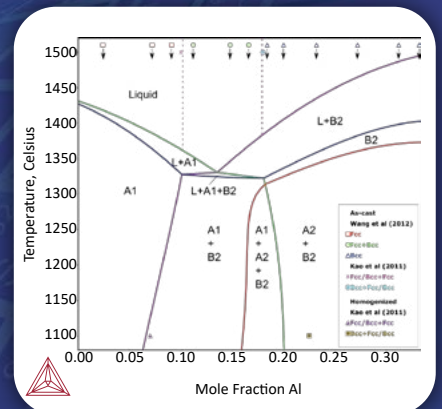
Comparison of calculated and experimental Ms temperatures for a wide range of steels

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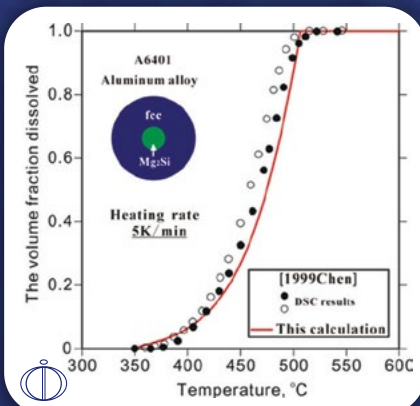
Variation in solidus temperature over 1000 compositions within alloy 718 specification

### High Entropy Alloys



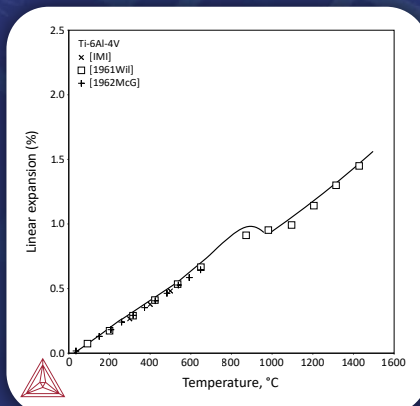
Calculated phase diagram along the composition line of CoCrFeNi-Al

### Al Alloys



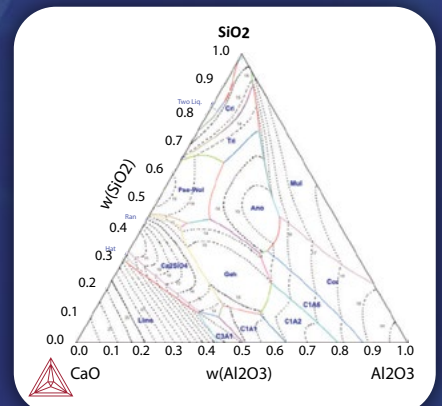
Dissolution of Mg<sub>2</sub>Si precipitate in Alloy A6401

### Ti and TiAl Alloys



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

### Oxides



Ternary liquidus projection in oxide systems