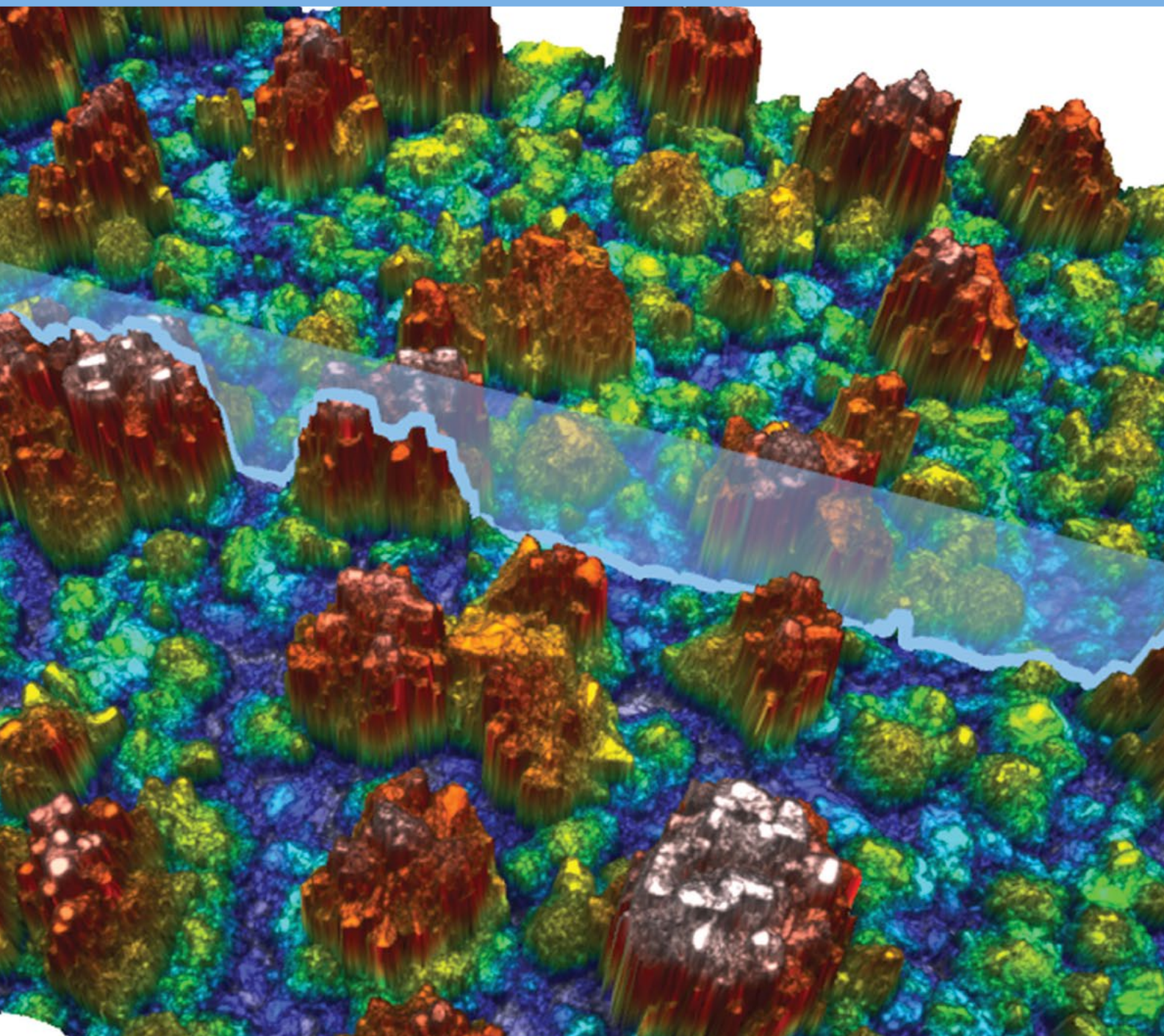


# JOM

SEPTEMBER 2019

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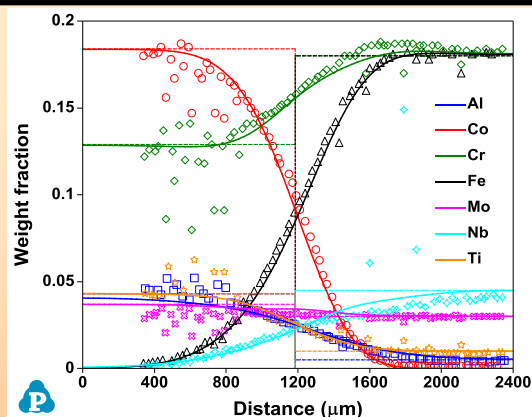
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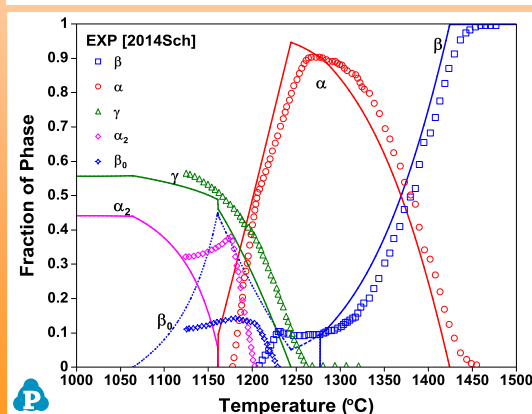
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# TMS

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## About the Cover

From "Suppression of Void Formation at Sn/Cu Joint Due to Twin Formation in Cu Electrodeposit" by Shan-Ting Tsai et al., the figure shows a 3D optical profile of Cu electroplated layers prepared using organic additives in addition to basic electrolytes. In this study, three Cu substrates were electroplated using various additive formulas. The authors found that organic additives resulted in an incorporation of a higher level of impurity in the Cu electroplated layers and also affected the atomic deposition behavior of Cu, which alters the grain microstructures.



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### Aluminum: Recycling and Environmental Footprint

*Aluminum Committee; Recycling and Environmental Technologies Committee*

David Wong, University of Auckland  
Pascal Lavoie, Consultant

### Advanced Electronic Interconnection

*Alloy Phases Committee*

Shih-Kang Lin, National Cheng Kung University

### Advances in Processing, Manufacturing, and Applications of Magnetic Materials

*Magnetic Materials Committee; Energy Conversion and Storage Committee*

Ikenna Nlebedim, Ames Laboratory  
Orlando Rios, Oak Ridge National Laboratory

### Recycling Methods for Industrial Metals and Minerals: Part I

*Recycling and Environmental Technologies Committee*

Dirk Verhulst, Consultant, Extractive Metallurgy and Energy Efficiency

Fiseha Tesfaye, Abo Akademi University

Mark E. Schlesinger, Missouri University of Science & Technology

### Solidification Defects in Additive Manufactured Materials

*Solidification Committee*

Lang Yuan, University of South Carolina

## About JOM:

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

## About TMS:

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

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# in the final analysis

*"I have always imagined that Paradise will be a kind of library."*

—Jorge Luis Borges

# JOM

Volume 71

Number 9

September 2019

Throughout history, there have been many, many visions for the hereafter, from the bucolic Elysian Fields of ancient Rome, the happy hunting grounds of the Lakota people, the Heavenly billowing clouds and flowing robes of Renaissance masters, and the less reverential Planet Orlando from Broadway's *Book of Mormon*. I quite fancy the notion of eternity as a library, being a complete yet ever-expanding reservoir of fact, scholarship, philosophy, and imagination. If I can write my own epitaph, three words will do: "Tell me more."

At risk of being too parochial, TMS is certainly in the "tell me more" trade with our journals, studies and roadmaps, courses, meetings, etc., etc. Another tell-me-more enterprise is the National Academy of Engineering (NAE). The interests and activities of NAE and TMS frequently complement each other. A recent intersection of common cause is the academy's effort, "Engagement of Engineering Societies in Undergraduate Engineering Education." Last December, NAE convened a workshop on this topic with the goal of exploring how engineering societies can help better align engineering education with the needs of industry.\*

TMS was well-represented by our immediate past Professional Development Director, Jeff Fergus (associate dean and professor of materials engineering, Samuel Ginn College of Engineering, Auburn University). He presented, "Meeting Industry's Educational Needs on Sustainability." Professor Fergus referenced a 2013 survey of TMS industrial members and noted that the respondents had indicated sustainability as an important consideration in business and technical decisions. However, the importance of sustainability is not reflected in graduating engineers' competencies. Professor Fergus gave credit to the four committees that comprise the Society's Professional Development Directorate as working to better prepare undergraduates for sustainability and other issues by developing short courses and webinars to meet the needs of industry and developing guidance to academic programs.

Aside from the 15 presentations, the workshop also held roundtable discussions to identify issues, barriers, and opportunities to close the gaps between industry and undergraduate education. This resulted in a series of recommendations for professional societies, including:

- Sponsor major student competitions and projects.
- Work with industry to create bodies of knowledge for engineers; develop courses for lifelong learning and mentorship programs for faculty; oversee micro-credentialing programs; and create opportunities in industry for faculty and postdocs.
- Help engineers returning to the workforce and provide a professional home for those transitioning between academia and industry.
- Establish apprenticeship programs and other partnerships.
- Facilitate connections between industry, colleges and universities, and pre-K through 12 education.

Those are a lot of good ideas and there are others. But, the participants recognize that challenges to realizing these recommendations are daunting and include competing organizational priorities as well as insufficiencies in information, leadership, understanding of value propositions, funding, staffing, and time—and not just within professional societies but industry and academia as well.

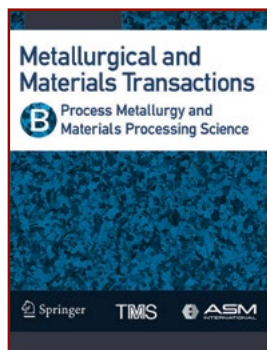
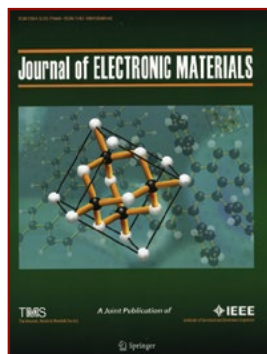
It seems a heavy lift. Still, like paradise, knowing where we want to be is the first step toward getting there.



James J. Robinson  
Executive Director

*"TMS is certainly in the 'tell me more' trade with our journals, studies and roadmaps, courses, meetings, etc., etc."*

\* National Academy of Engineering 2019. *Engineering Societies' Activities in Helping to Align the Needs and Goals of Industry and Academia: Proceedings of a Workshop in Brief*. Washington, D.C.: The National Academies Press. <https://doi.org/10.17226/25445>.



## 2018 Impact Factors Released for TMS Journals; New ICME Award; TMS Members Honored by MetSoc

### Impact Factors Increase for TMS Journals

The Impact Factors (IF) for TMS's four long-established journals continue their upward trend with the recent release of the 2018 Journal Citation Reports (Clarivate Analytics, 2019).

Impact Factor is the average number of citations counted in a given Impact Factor year for articles published in the two preceding years. It is based on the number of citations of a journal's content divided by the number of citable articles published by that journal. Authors often refer to the IF of a journal for guidance when seeking to maximize exposure of their work.

What follows are the 2018 numbers for each journal (with 2017 numbers in parentheses):

- *JOM*: 2.305 (2.145)
- *Journal of Electronic Materials*: 1.676 (1.566)
- *Metallurgical and Materials Transactions A*: 1.985 (1.887)
- *Metallurgical and Materials Transactions B*: 1.952 (1.834)

While IF can vary from year to year for a variety of reasons, TMS journals have generally tracked in a positive direction (see Figure 1), and also have achieved strong placement in Clarivate's ranking by subject categories (see Table I).

To access TMS's entire library of journals, visit the Journals section within the Publications tab on the TMS website at [www.tms.org](http://www.tms.org). Through this portal, TMS

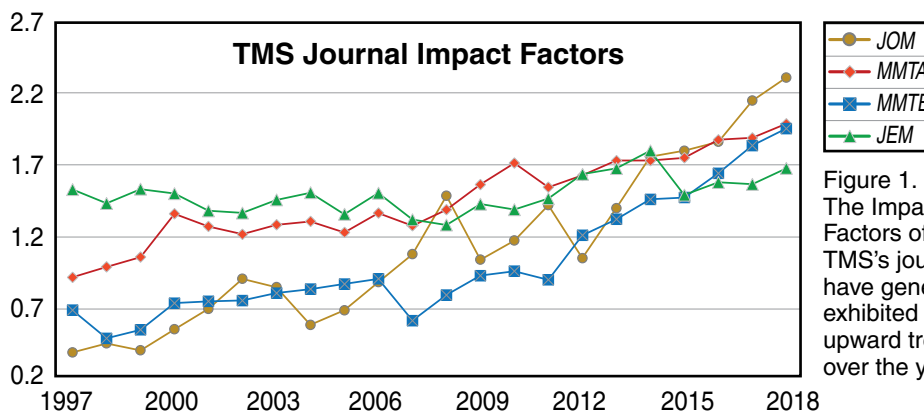


Figure 1. The Impact Factors of TMS's journals have generally exhibited an upward trend over the years.

Table I: TMS Journal Rank by Subject Category

Category Name	Total Journals 2018	JOM	MMTA	MMTB	JEM
Materials Science, Multidisciplinary	293	142	163	169	195
Metallurgy & Metallurgical Engineering	76	17	19	20	-
Mineralogy	29	11	-	-	-
Mining & Mineral Processing	19	5	-	-	-
Engineering, Electrical & Electronic	265	-	-	-	162
Physics, Applied	148	-	-	-	85

Table I. This table presents all the subject categories assigned to TMS journals, as well as the rank of TMS journals within these categories.

members have free access to current and archived issues of all TMS journals as well as 20 other materials-related journals

published by Springer. Remember to first log in to the TMS website and then select the journal that you wish to read.

## New ICME Award from TMS

TMS's new **ICME Industry Implementation Award** recognizes the significant achievements that industry has made to implement integrated computational materials engineering (ICME) methods into a manufacturing process and/or design of a new material. This division-level award is sponsored by the TMS Materials Processing & Manufacturing Division. It will be awarded every two years at the ICME World Congress, where award recipients will be honored with a keynote presentation at that year's meeting, along with a complimentary registration.

Individuals or teams interested

in applying should demonstrate the implementation of an ICME process that integrates computational and experimental methods across at least two length and/or time scales to accelerate the design and/or optimization of new material and/or manufacturing process. Impact of the implementation should have been made public within the last five years of the nomination.

Applications must be submitted to [awards@tms.org](mailto:awards@tms.org) by **April 1, 2020**, to be considered for the 2021 award. Visit [awards.tms.org](http://awards.tms.org) for a complete list of award criteria and for more information on applying.



**Boyd Davis**



**Hatem Zurob**

## TMS Members Receive MetSoc Awards

Congratulations to the following TMS members for being honored by The Metallurgy & Materials Society (MetSoc) of the Canadian Institute of Mining, Metallurgy and Petroleum (CIM). The awards were presented at the MetSoc Awards Banquet on August 20, during the 2019 Conference of Metallurgists (COM 2019) in Vancouver.

### Silver Medal

#### Boyd Davis

Principal, Kingston Process Metallurgy Inc.

*TMS member since 1999*

The Silver Medal recognizes an individual who has contributed over a long period of time to the growth of MetSoc.

### MetSoc Brimacombe Award

#### Hatem Zurob

Professor and Chair, Department of Materials Science and Engineering, McMaster University

*TMS member since 1996*

The Brimacombe Award recognizes young achievers who have made noteworthy

contributions in any of the scientific and technological disciplines relevant to MetSoc.

### MetSoc Award for Research Excellence,

*sponsored by Rio Tinto*

#### Hani Henein

Professor, Alberta University  
*TMS member since 1981*

MetSoc's highest honor for metallurgical contribution by an academic or research scientists in a Canadian research laboratory or Canadian university, this award recognizes lifetime achievement in teaching and research resulting in significant metallurgical developments.

### MetSoc Masters Scholarship

#### Justin Plante

Student, Université Laval  
*TMS member since 2016*

The MetSoc Masters Scholarship encourages and supports the attainment of educational goals by masters' students who have demonstrated a high level of academic achievement at a Canadian university.



**Hani Henein**



**Justin Plante**

## member news

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





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

## ***In Case You Missed It:*** **Business News from the Field**

### **TDK Invests in Materials Science with New CVC**

**Tokyo, Japan:** Japanese electronics company TDK Corporation has announced that they are establishing a corporate venture company (CVC), TDK Ventures Inc. With a starting fund of \$50 million, the venture will invest in early-stage startups in the fields of materials science, energy/power, and other related areas, fitting with TDK's manufacture of electronic materials, electronics components, and recording and data-storage devices. Startups under the CVC will be provided with access to TDK resources, including potential customers, channels, and operating expertise, while TDK hopes to leverage fundamental materials science to unlock a sustainable future.

### **Bilmax Bought by Gelest** **Morrisville, Pennsylvania, USA:**

Gelest Inc., a manufacturer and supplier of silicones, organosilanes, and metal-organics, has purchased Bilmax. With the acquisition of the specialty monomer and polymer manufacturer and marketer, Gelest hopes to expand both its R&D and production capabilities. Terms of the

deal indicated that Bilmax will continue to operate under the same name and that Bilmax employees will be retained in their current roles.

### **DRA Global Awarded BFS Contract**

**Tizert, Morocco:** Canadian engineering group DRA Global has been awarded a contract to complete the bankable feasibility study (BFS) at the Tizert copper project in Morocco. The deposit, owned by the Managem Group, is estimated to be the largest copper deposit in the western Anti-Atlas copperbelt. The BFS, which includes mining, backfill, ore transport, and process plant/infrastructure, is to be completed in the second quarter of 2020.

### **Kokusai Electric Acquired by Applied Materials**

#### **Santa Clara, California, USA:**

California-based supplier of equipment, services, and software for the semiconductor manufacturing industry Applied Materials has announced the acquisition of Kokusai Electric Corporation. The Japanese provider of batch processing systems and services for memory, foundry, and logic customers will be folded into Applied's Semiconductor Products Group. Operation of Kokusai Electric will remain in Tokyo, with manufacturing centers in Toyama, Japan, and Cheonan, South Korea.

### **Lucid Motors Hires Tesla's VP of Manufacturing**

#### **Newark, California, USA:**

Peter Hochholdinger, former vice president of manufacturing for Tesla Inc., has joined Lucid Motors as its new head of manufacturing operations. Hochholdinger joins the luxury electric vehicle (EV) producer after a \$1 billion investment from the Saudi Arabian Private Wealth Fund last April, in an effort to reach production of its Lucid Air EV. The Lucid Airs will be built at a new factory, funded through the same Saudi investment fund, in Casa Grande, Arizona. Additionally, Lucid has announced that it will offer Lucid Air buyers access to Electrify America chargers rather than producing its own fast chargers.



**Bethesda, Maryland, USA:** American defense and aerospace company Lockheed Martin has signed an additive manufacturing agreement with Airbus subsidiary Premium AEROTEC. The agreement outlines plans to identify components of Lockheed Martin's F-35 Lightning II aircraft (pictured) that could be manufactured using Premium AEROTEC's additive processes. Based in Germany, Premium AEROTEC currently uses a five-axis processing center to manufacture aluminum fuselage frames for Airbus aircrafts. (Photo courtesy of Lockheed Martin.)

# Standing up for Science: My Journey as a Congressional Fellow

Michele Bustamante



Michele Bustamante (left) meets science communicator Bill Nye "The Science Guy" during her fellowship.



Bustamante (background) and Senator Edward J. Markey attend the confirmation hearing for Andrew Wheeler, administrator of the Environmental Protection Agency.



Michele Bustamante

For the past year, I've had the privilege of working as the 2018–2019 TMS/Materials Research Society (MRS) Congressional Science and Engineering Fellow in the office of U.S. Senator Edward J. Markey (D-MA). In this role, I leveraged my training as a scientist to serve the people of Massachusetts in federal policymaking related to science, energy, and the environment. I have seen, learned, and experienced more than I could have ever imagined in this role,

and I am so glad that I took the chance to explore life outside the lab. It is my sincerest hope that if you're reading this, you might consider doing the same. Now, more than ever, it is important for scientists to be paying attention.

## How I Launched my New Career in Policy

Ironically, I was never all that into politics. Historically, you would be much more likely to find me sitting in front of a

## Apply for the TMS/MRS Congressional Fellowship

TMS and the Materials Research Society (MRS) are now accepting applications for the 2020–2021 TMS/MRS Congressional Science and Engineering Fellowship, under the auspices of the American Association for the Advancement of Science (AAAS).

To be considered for the fellowship, applicants must have a record of success in research or scholarship in a field relevant to materials science, while also demonstrating a strong interest in applying scientific and technical knowledge to U.S. public policy issues. An applicant is expected to be a member of or applicant for membership of TMS or MRS, and must have a Ph.D. by September 1, 2020. U.S. citizenship is not required, but applicants must be authorized to work in the United States.

**For additional information on the fellowship, contact Mary Samsa, TMS Foundation & Public Affairs Manager, at [msamsa@tms.org](mailto:msamsa@tms.org).**

*"I have seen, learned, and experienced more than I could have ever imagined in this role, and I am so glad that I took the chance to explore life outside the lab. It is my sincerest hope that if you're reading this, you might consider doing the same."*

**—Michele Bustamante**





Michele Bustamante in the office of Rafael Reif (right), Massachusetts Institute of Technology (MIT) President, after a meeting between Reif and Senator Edward J. Markey. Markey and Bustamante visited MIT to attend The Environmental Solutions Initiative People & the Planet Lecture Series, in which the senator gave a speech entitled, “Combating the Climate Crisis: from Regulation to Legislation.”

computer straining over minute details of a spreadsheet model than out marching in protests or calling my representatives. In fact, for most of my life, I didn’t pay much attention to what was going on in politics at all. So how exactly did someone like me end up here, in our nation’s capital, working on the front lines of some of the most hotly debated issues of our time? Let me explain.

At the time of the 2016 presidential election, I was four months into my postdoc in an interdisciplinary materials research lab at the Massachusetts Institute of Technology. I had been trained as a Ph.D. not in materials science, but in sustainability, as part of the fourth-ever

cohort of sustainability Ph.D. students at the Rochester Institute of Technology. When I graduated, I had the honor of speaking at our convocation ceremony. In my speech, I beamed about the new global climate agreement that had been reached just six months earlier in Paris; my fellow graduates and I could head into the world with global groundwork for cooperation paving the road ahead. At the time, I still felt my role would be in a technical capacity, so I stayed in academics.

After the 2016 election, however, I found myself increasingly preoccupied. As a scientist, I began to see my profession become increasingly politicized, as people with and without scientific backgrounds argued over facts. And as a sustainability scientist, I worried about actions taken to reverse U.S. involvement in climate-related programs, like the U.N.’s Paris Agreement. Fortunately, I also began to see scientists becoming more vocal; some even taking to the streets in the 2017 March for Science. Inspired as I was, I felt motivated to go a different route than taking to the streets. In typical fashion, I headed to my computer, but this time it was to apply for a new job that would allow me to jump right into the heart of the action in D.C.—this fellowship.

### My Year-Long March for Science

By September 2018, I was off. Starting out, the learning curve was steep but resources and support were abundant. I was delighted to find so many offices



Bustamante (second from right) participates in a volunteer workshop for Arizona State University’s Science Outside the Lab program during her time on the Hill.



## Meet the 2019–2020 Congressional Fellow



**Alexander Martin**

Alexander Martin begins his one-year term in September as the 2019–2020 TMS/MRS Congressional Science and Engineering Fellow. Through the fellowship, he will serve as a special legislative assistant on the staff of a member of Congress or congressional committee, bringing his technical and scientific background and external perspectives to the decision-making process in Congress.

“During my time on the Hill, I am excited to use my technical background in physical chemistry and materials science to advise policymakers on energy and climate policy topics,” said Martin. “The congressional fellowship provides a unique opportunity for scientists to develop an understanding of the political and procedural elements that accompany policy analysis throughout the legislative process. I am looking forward to learning how science and scientists can best help policymakers to enact evidence-based legislation that benefits society.”

Previously a postdoctoral fellow in the Molecular Design Institute at New York University’s (NYU) Department of Chemistry, Martin earned his Ph.D. in physical chemistry from NYU in 2018 and his B.S. in chemistry from Boston College in 2013. Through the TMS/MRS Congressional Science and Engineering Fellowship, Martin hopes to address legislative issues related to vehicle fuel economy standards, electrical grid modernization, renewable energy, and industrial decarbonization.

Martin will begin his fellowship in early September in Washington, D.C., with an intensive science policy orientation, followed by an interview and selection process with offices of senators, representatives, or committees on Capitol Hill. Offices will extend offers, and he will choose the office in which to spend his fellowship year.

looking for fellows to work on energy and environmental issues, and I was lucky enough to find placement in an office that provided me with the opportunity to cover both science and climate portfolios.

My first major task came three weeks into my fellowship. The U.N.’s Intergovernmental Panel on Climate Change released its special report, *Global Warming of 1.5°C*, and I was responsible for distilling the thousands of pages of detail into briefings for the senator. One month later, the same situation occurred when the U.S. Global Change Research Program released the *Fourth National Climate Assessment*. The findings of these two reports echoed the same warning and became a guiding light for our action: millions of human lives, natural wonders like our coral reefs, and billions of dollars in economic damages are at stake. Yet those of us who advocated for action continued to come up against resistance to these conclusions.

Despite challenges, there have been many moments that gave me hope.

Members of Congress attended weekly meetings that I helped organize with experts from climate-intersecting fields, including environmental justice, national security, human displacement, and every economic sector. And, through application of key climate report findings, I got to contribute to a movement that is changing the conversation on climate change.

Overall, this experience has left me feeling more empowered and hopeful than I ever could have felt by watching from afar. This has been just a peek behind the curtain that allowed me to see beyond the individuals standing in front of the camera, to the teams of incredible hardworking public servants behind them. Anytime a move is made against science or climate change, my colleagues spring into action. I have witnessed first-hand that there are people standing up for scientific reason, and I’m proud to have been one of them this past year.

**Michele Bustamante is  
the 2018–2019 TMS/MRS  
Congressional Science and  
Engineering Fellow.**



# International Scholar Program Offers a World of Experience

**Fadi Abdeljawad**



**JIM/TMS Young Leaders  
International Scholar Award**



Fadi Abdeljawad, 2019 JIM/TMS Young Leaders International Scholar, with JIM President Satoshi Sugimoto (left) and JIM Secretary General Hideaki Yamamura (right) at the JIM 2019 Annual Spring Meeting.



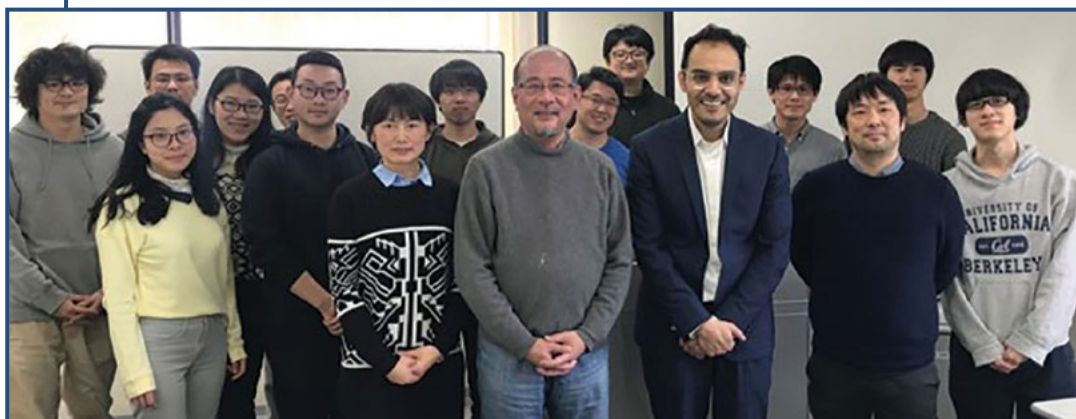
**Fadi Abdeljawad**

I was introduced to Japan at a very young age. I grew up in a part of the world where *Captain Tsubasa*, the animated Japanese soccer *manga* series, was every child's favorite TV show—it was, and still is, one of my favorite shows. I was deeply honored to be selected as the 2019 Japan Institute of Metals and Materials (JIM)/TMS Young Leaders International Scholar. I would like to extend my deep appreciation to the TMS Foundation and JIM for making my visit to Japan possible. In addition to attending the JIM 2019 Annual Spring Meeting, which was held at the Tokyo Senju campus of Tokyo Denki University, my trip included visits to Kyoto University, where Nobuhiro Tsuji, professor, Department of Mechanical Engineering, hosted me, and

to the University of Tokyo, where Yasushi Shibuta, associate professor, Department of Materials Engineering, was my host.

My trip to Japan started a few days after the TMS 2019 Annual Meeting & Exhibition in San Antonio. I flew back to Clemson, South Carolina, for a few days before departing to Japan's Narita airport, a fifteen-hour flight from the Dallas Fort Worth airport. Upon my arrival, I took the airport express to the Tokyo station, then the shinkansen-Nozomi bullet train to Kyoto, where I spent the night.

The next morning, I met Reza Gholizadeh from Tsuji's research group, who arranged a tour of the Kyoto University campus and several experimental facilities that are focused on materials synthesis, processing, and



Fadi Abdeljawad (front row, third from right) with members of Nobuhiro Tsuji's (front row, fourth from right) research group at Kyoto University.





Abdeljawad (sixth from left) also spent time with members of Yasushi Shibuta's research group at the University of Tokyo. Among the group members pictured are: Shibuta (fifth from left); Tomohiro Takaki (fourth from right); and Naoya Shibata (first from left).

testing. Tsuji then arranged for me to give a presentation in the Department of Materials Science and Engineering on my research work on atomistic and phase field modeling of grain boundary solute segregation in metals, which is sponsored by U.S. Department of Energy, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering. I met with members of Tsuji's research group and discussed work on the synthesis of nanocrystalline materials. In the evening, I took the shinkansen train back to Tokyo to prepare for my next stop, the University of Tokyo.

The next day, I met with Shibuta, who arranged a meeting with Tomohiro Takaki, a professor of mechanical engineering at the Kyoto Institute of Technology. Again, I was invited to give

a talk about my current research efforts and afterward, we engaged in several discussions on the modeling techniques of metal solidification and grain growth kinetics.

After I concluded my visit to the University of Tokyo, I went back to the Senju district in Adachi for the JIM meeting, which was held from March 20–22. On the first day of the meeting, I was introduced to the attendees during the opening and awards ceremony by Hideaki Yamamura, the Secretary General of JIM. I am deeply grateful to Yamamura for his assistance during the planning stages of my trip and in navigating the elaborate network of trains and subways in Tokyo. On Thursday, March 21, I gave an invited presentation entitled, "Atomistic and Mesoscale Modeling

## Give Back with the TMS Foundation



Giving promising young minerals, metals, and materials scientists and engineers an opportunity to develop scientific collaborations across global cultures is the goal of the TMS Young Leaders International Scholar Program, made possible by the TMS Foundation. Since 2006, both TMS and the Japan Institute of Metals and Materials (JIM) have selected young professionals, through a competitive review of their accomplishments, to travel to the

other organization's annual meetings to present scientific papers and participate in learning and networking activities. A similar effort was launched in 2013 with the Federation of European Materials Societies (FEMS).

Making a gift to the TMS Foundation will help to ensure that the TMS Young Leaders International Scholar Program continues to engage future generations of professionals in important international collaborations.

Visit the TMS Foundation website at [www.TMSFoundation.org](http://www.TMSFoundation.org) to learn more and make an online contribution. **For questions, contact TMS Foundation staff at [TMSFoundation@tms.org](mailto:TMSFoundation@tms.org).**



*"My trip to Japan allowed for great research discussions and afforded me the invaluable opportunity to expand my professional network."*

**—Fadi Abdeljawad**



Hidehiro Yoshida (left), professor, University of Tokyo, presents Abdeljawad with the 2019 JIM/TMS Young Leaders International Scholar certificate during the JIM Annual Spring Meeting.

of Nanoscale Sintering: Application to Direct Ink Write Additive Manufacturing," in the Powder and Sintering Materials session. At the conclusion of my talk, I was presented with the JIM/TMS Young Leaders International Scholar certificate, acknowledging my participation in the program and attendance of the meeting. My trip to Japan allowed for great

research discussions and afforded me the invaluable opportunity to expand my professional network.

After the meeting, I was able to make some additional stops before coming back home. I was fortunate enough to visit Japan when the cherry trees started to blossom, providing me with an abundance of splendid views of white and pink *sakura*. The Fushimi Inari Taisha shrine in Kyoto was a magnificent place to visit, and the bustling Nishiki Market was also a must-see stop. For seafood enthusiasts—the world's largest Tsukiji fish market near the Ginza neighborhood in Tokyo is a superb place to spend some time.

I have always enjoyed getting lost in big cities and there is no better place to do so than Tokyo. Japan is a country where tradition and modernity meet in a harmonious coexistence; it is a place that demands one's respect. I enjoyed many experiences during my visit to Japan and created great memories there. I am deeply thankful to the TMS Foundation and JIM for making my visit possible and to Tsuji, Shibuta, and Takaki for hosting me.

**Fadi Abdeljawad is an assistant professor at Clemson University and the 2019 JIM/TMS Young Leaders International Scholar. He is also the recipient of the 2015 TMS Functional Materials Division Young Leaders Professional Development Award.**



## Meet the 2019 JIM Representative, Sakiko Kawanishi



Sakiko Kawanishi (pictured, left) presented her paper, "An Approach for Solubility Measurement of SiC in Molten Silicon and its Alloy by Real-Time Interference Observation," at the TMS 2019 Annual Meeting & Exhibition, held March 10–14, in San Antonio, Texas, as the 2019 JIM representative in the Young Leaders International Scholar Program. Her travel was supported by JIM, just as TMS and the TMS Foundation support one early career member to travel to JIM's Annual Spring Meeting. Following the conference, she planned to visit labs at the Massachusetts Institute of Technology and at Stony Brooke University in New York. Kawanishi is currently an assistant professor in the Institute of Multidisciplinary Research for Advanced Materials at Tohoku University.



# TMS meeting headlines

View all upcoming meetings online at [www.tms.org/Meetings](http://www.tms.org/Meetings).

## Other Meetings of Note

### ANS/TMS Materials in Nuclear Energy Systems (MINES 2019)

October 6–10, 2019  
 Baltimore, Maryland, USA

### OTC Brasil 2019

October 29–31, 2019  
 Rio de Janeiro, Brazil

### OTC Asia 2020

March 24–27, 2020  
 Kuala Lumpur, Malaysia

### Offshore Technology Conference (OTC) 2020

May 4–7, 2020  
 Houston, Texas, USA

### The 11th International Conference on Molten Slags, Fluxes and Salts (Molten 2020)

May 25–29, 2020  
 Seoul, South Korea

### The 13th International Conference on the Technology of Plasticity (ICTP 2020)

July 26–31, 2020  
 Columbus, Ohio, USA

### The 14th International Symposium on Superalloys (Superalloys 2020)

September 13–17, 2020  
 Seven Springs, Pennsylvania, USA

### Materials Science & Technology 2020 (MS&T20)

October 4–8, 2020  
 Pittsburgh, Pennsylvania, USA

## MS&T19

MATERIALS SCIENCE & TECHNOLOGY

September 29–October 3, 2019

Oregon Convention Center

Portland, Oregon, USA

[www.matscitech.org](http://www.matscitech.org)

- There's still time to attend Materials Science & Technology 2019 (MS&T19). Visit the MS&T19 website to register and view technical program details to start planning your conference experience today.
- Gain expertise and insight by participating in the Additive Manufacturing Materials and Processes Workshop on Sunday, September 29. This program will be taught by additive manufacturing experts *David L. Bourell*, The University of Texas at Austin; *Sudarsanam Suresh Babu*, University of Tennessee-Knoxville; *Howard A. Kuhn*, University of Pittsburgh and America Makes; and *Kirk Rodgers*, The Barnes Group Advisers.



November 17–20, 2019

Hyatt at Olive 8

Seattle, Washington, USA

**Discount Registration Deadline:**

**October 7, 2019**

[www.tms.org/HEA2019](http://www.tms.org/HEA2019)

- The World Congress on High Entropy Alloys (HEA 2019) not only includes technical talks on materials with high configurational entropy from experts in the field, but also unique social events like the Boeing Future of Flight Tour. Sign up for the tour is available through the congress website.
- Book your room at the congress location, the Hyatt at Olive 8, by October 25 for convenient access to HEA 2019 technical sessions and events.

THE WORLD COMES HERE

## TMS2020

149th Annual Meeting & Exhibition

February 23–27, 2020

San Diego Convention Center and

Marriott Marquis & Marina

San Diego, California, USA

**Registration Opens Soon!**

[www.tms.org/TMS2020](http://www.tms.org/TMS2020)

- Plan ahead for your travel to the TMS 2020 Annual Meeting & Exhibition (TMS2020)—begin the visa application process now. Visit the TMS2020 website to request an official visa invitation letter.
- Held each year at the TMS annual meeting, the Light Metals Keynote will present a series of invited speakers from the field. At TMS2020, the session will focus on the topic of attracting and growing the next generation of technical talent for the light metals industry.

Congress on

## SAFETY

in Engineering and Industry 2020

June 21–24, 2020

Philadelphia Marriott Downtown

Philadelphia, Pennsylvania, USA

[www.SafetyCongress.org](http://www.SafetyCongress.org)

- The Congress on Safety in Engineering and Industry 2020 (Safety Congress 2020) will feature a cross-section of thought leaders representing industry, regulatory organizations, and academia to share best practices and perspectives on the future of safety management.
- Learn more about topics under development for this program—including breakout sessions for Management Systems, Technology and Techniques, and Human Resources—on the Program page of the congress website.
- Be among the first to know about program updates, special events, and when registration opens by signing up to receive e-mail updates on the Safety Congress 2020 website.





# call for papers

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



## March 2020:

**Manuscript Deadline: October 1, 2019**

**Topic: Additive Manufacturing: Validation and Control**

**Scope:** While research continues on the fundamental aspects of additive manufacturing (AM), it is the ability to produce repeatable properties and microstructures that is required to incorporate AM as a primary manufacturing process. Modeling and simulation strategies are being developed to provide benchmarks for the validation and control of the AM process. Manuscripts are solicited that address approaches toward validating process modeling and incorporation into process control.

**Editor:** Judy Schneider

**Sponsors:** Additive Manufacturing Committee

**Topic: Advanced Manufacturing for Biomaterials and Biological Materials**

**Scope:** Manufacturing and processing are becoming increasingly important for biomaterials, bioinspired materials, and biological materials. This includes additive manufacturing techniques like 3D printing, which allow for increasing degrees of complexity to mimic the structures observed in nature. This special topic welcomes any other processing and manufacturing techniques applicable for these materials, such as plasma treatments.

**Editors:** Hannes C. Schniepp, Steven Eric Naleway, Vinoy Thomas, and David Restrepo

**Sponsors:** Biomaterials Committee

**Topic: Solid Freeform Fabrication 2019**

**Scope:** This special topic will feature invited papers from the 2019 Solid Freeform Fabrication symposium, covering all aspects of additive manufacturing. Best papers from the symposium dealing with materials issues will be recommended for publication in *JOM*.

**Editor:** David Bourell

**Sponsors:** Invited

## April 2020:

**Manuscript Deadline: November 1, 2019**

**Topic: Aluminum and Magnesium: New Alloys and Applications**

**Scope:** This topic covers the development of new alloys, optimization of commercial alloys, additions for structure modification, and improvement of mechanical and functional properties, as well as new applications of aluminum and magnesium alloys. Papers are invited that contain essentially new data based on advanced characterization and analysis techniques as well as thermodynamic analysis and testing for properties.

**Editor:** Dmitry Eskin

**Sponsors:** Aluminum Committee

**Topic: Biologically Induced Corrosion**

**Scope:** Papers in all areas of biologically induced or influenced corrosion are welcome. Examples include microbially induced corrosion, corrosion in biomedical devices, etc.

**Editor:** Vilupanur Ravi

**Sponsors:** Corrosion and Environmental Effects Committee

**Topic: Characterization of Advanced Biomaterials**

**Scope:** Papers are invited on advances in processing or relevant property measurement of novel biomaterials, particularly those on synthesis, processing, and characterization. Of interest are multifunctional nanomaterials and modified mineral-based biomaterials with unique combinations of desirable mechanical performance, biocompatibility, and bioactivity for clinical applications.

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

**Sponsors:** Materials Characterization Committee

**Topic: Hydrogen Effects on Material Performance**

**Scope:** Numerous energy generation and transportation systems constructed of high-performance metal alloys are routinely exposed to hydrogen. The integrity of these systems is often challenged by a variety of hydrogen



degradation modes. The hydrogen-material interactions that ultimately lead to degradation occur across multiple length scales. Therefore, of particular interest for this special topic are studies involving multiscale experimental and theoretical methods for probing hydrogen-materials interactions in complex materials systems.

**Editors:** Janelle Wharry and Samantha Lawrence

**Sponsors:** Nanomechanical Materials Behavior Committee

## May 2020:

**Manuscript Deadline: December 1, 2019**

### Topic: Advancing Development and Application of Superalloys

**Scope:** This topic focuses on the current advances in the development and application of Ni- and Co-based superalloys. Areas of interest may include (but are not limited to): alloy development, advanced processing, deformation behavior, structure-property relationships, long-term stability, environmental damage, and joining.

**Editor:** Martin Detrouis

**Sponsors:** High Temperature Alloys Committee

### Topic: Emerging Mechanisms for Enhanced Plasticity in Magnesium

**Scope:** This special topic covers emerging methods that overcome this limitation. The scope is inherently multi-scale, ranging from fundamental mechanisms at the atomic/crystal defect level, up to large-scale production techniques. Optimizing mechanical properties via microstructure and crystallographic texture modification are considered; chemistry control and alloying, casting, powder-based strategies, as well as thermomechanical processing, are addressed.

**Editors:** Petra Maier and Jishnu J. Bhattacharyya

**Sponsors:** Magnesium Committee

### Topic: Heat Transfer Utilization in Pyrometallurgy

**Scope:** This topic covers some of the fundamentals and applications of heat transfer in pyrometallurgy. In particular, this topic aims to highlight how the knowledge and investigation of heat transfer modes drive furnace design and operation. Included are practical applications to industrial furnaces, with an emphasis on furnace heat management and heat utilization for process optimization.

**Editors:** Camille Fleurialt and Joseph Grogan

**Sponsors:** Pyrometallurgy Committee

### Topic: In-Situ Characterization Techniques for Investigating Nuclear Materials

**Scope:** For this topic, we are soliciting papers on in-situ experimental techniques at all length scales probing mechanical, chemical, thermal, or electrical responses, as well as irradiation damage. Papers that include modeling and simulation are welcome, though computational-only papers will not be accepted.

**Editors:** Clarissa Yablinsky, Peter Hosemann, David Frazer, and Shradha Agarwal

**Sponsors:** Nuclear Materials Committee

## June 2020

**Manuscript Deadline: January 1, 2020**

### Topic: Advanced Characterization of Interfaces and Thin Films

**Scope:** The focus of this topic is the advanced characterization of materials interfaces at atomic and nanoscales in metal, alloys, ceramics, and polymers by various in-situ and ex-situ experimental techniques such as x-ray and neutron diffraction, scanning electron microscopy, transmission electron microscopy, and atomic force microscopy. This topic also involves the understanding of materials interfaces by theoretical modeling approaches that allow the study of these processes on the atomic and molecular level.

**Editors:** Ritesh Sachan, Manuel Roldan Gutierrez, and Amit Pandey

**Sponsors:** Thin Films and Interfaces Committee

### Topic: Electrochemical Energy Conversion and Storage

**Scope:** Papers are sought on topics related to, but not restricted to: solid oxide and proton exchange membrane fuel cells, electrolyzers, batteries for energy storage, and hydrogen storage. Papers can address issues related to electrode, electrolyte and interconnection materials, electrochemical processes at electrodes and electrolyte interfaces, catalysts and catalytic mechanisms, infiltration to enhance catalytic activity and reduce poisoning effects, durability issues, and advances in characterization and modeling techniques.

**Editors:** Soumendra N. Basu and Partha P. Mukherjee

**Sponsors:** Energy Conversion and Storage

### Topic: Metal and Polymer Matrix Composites

**Scope:** This topic will cover recent progress in metal and polymer matrix composites, including: fiber-reinforced composites; natural fiber reinforced composites; solid and hollow particle reinforced composites; nanocomposites; fabrication methods and surface modification of micro- and nanoscale reinforcements; development of processing methods for composite materials; and modeling and simulation.

**Editors:** Nikhil Gupta and Tomoko Sano

**Sponsors:** Composite Materials Committee

### Topic: Quantum Materials for Energy-Efficient Computing

**Scope:** A significant portion of electricity consumption in the U.S. is due to the usage of computers. Quantum materials hold great potential for becoming crucial components of future generations of computers, which will be more energy-efficient. This special topic covers various state-of-the-art computational techniques, such as density-functional theory calculations that provide deeper understanding of quantum materials and accelerate their discovery.

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

**Sponsors:** Computational Materials Science and Engineering Committee

**REGISTRATION OPENS IN OCTOBER!**

**THE WORLD COMES HERE**

# **TMS 2020**

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



February 23-27, 2020 • San Diego, California, USA  
#TMSAnnualMeeting

## **WHAT CAN YOU EXPECT AT THE TMS 2020 ANNUAL MEETING & EXHIBITION?**



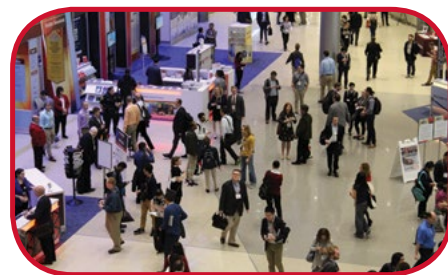
### **Comprehensive Coverage:**

We're building one of our most extensive technical programs yet for 2020, with more than 4,000 presentations planned at more than 85 symposia.



### **Two Events for the Price of One:**

The 9th International Symposium on Lead and Zinc Processing 2020 will be co-located with TMS2020, giving you access to both events with your registration.



### **A Global Meeting Place:**

Scientists and engineers from around the world will travel to TMS2020 to deliver updates on their latest work, to learn from their peers, and to engage with their international colleagues.



Learn more at: [www.tms.org/TMS2020](http://www.tms.org/TMS2020)

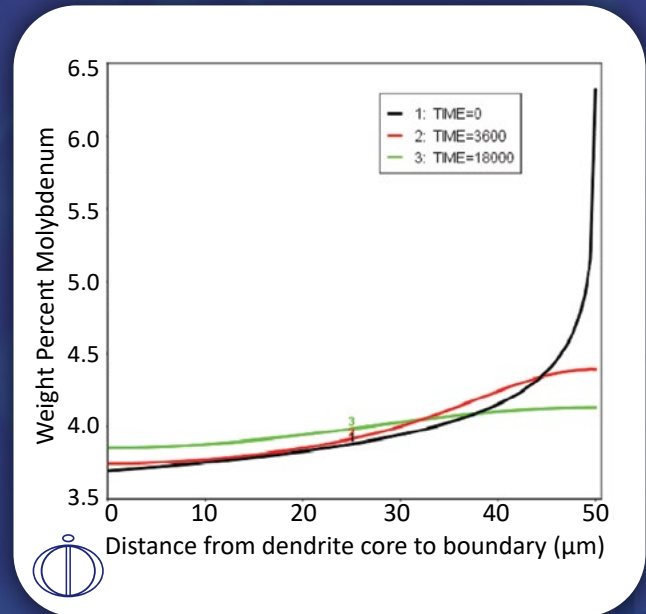


# Thermo-Calc Software

**Powerful Software for Thermodynamic and Diffusion Calculations**

## Software packages:

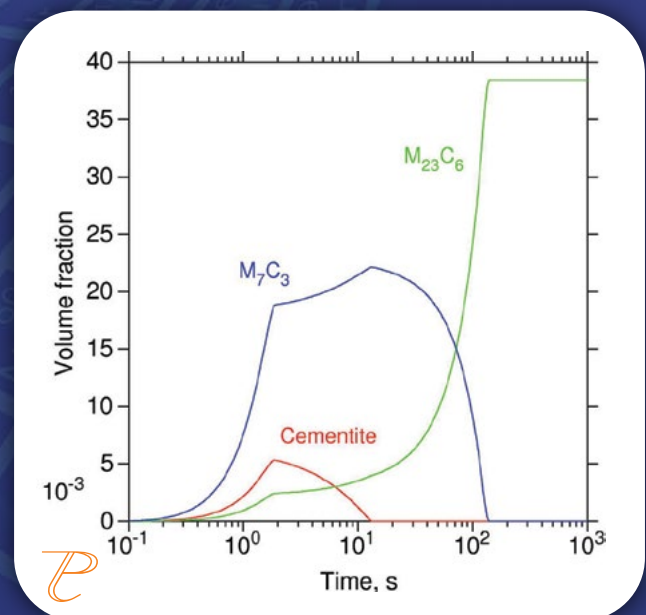
- ✓ **Thermo-Calc** for thermodynamics and phase equilibria in multicomponent systems
- ✓ **Diffusion module (DICTRA)** for modelling diffusion controlled transformations
- ✓ **Precipitation module (TC-PRISMA)** for modelling precipitation kinetics
- ✓ **Software development kits** for linking Thermo-Calc to your own software codes
- ✓ **Over 40 Databases** for thermodynamic and mobility applications



## Highlights of 2019b release:

- ✓ **New Process Metallurgy Module** - a new calculator within Thermo-Calc that makes it easy to set up calculations for steel and slag mixtures. The new module is designed for applications to steel-making and steel refining processes including converters, such as basic oxygen furnaces, electric arc furnaces, ladle furnace metallurgy, etc.
- ✓ **New Growth models in Precipitation Module** - Paraequilibrium (PE) and Non-Partition Local Equilibrium (NPLE) are now supported.
- ✓ **New Databases TCOX9, TCCU3, MOBCU3** - Ti has been added to the elements included in the refractory oxide database, TCOX9. Ge has been added to the elements included in the databases for copper alloys, TCCU3 and MOBCU3

## Homogenization of casting segregation in Ni Alloy 713



## Precipitation of stable/metastable carbides in 12Cr steels

## Thermo-Calc 2019b now available:

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