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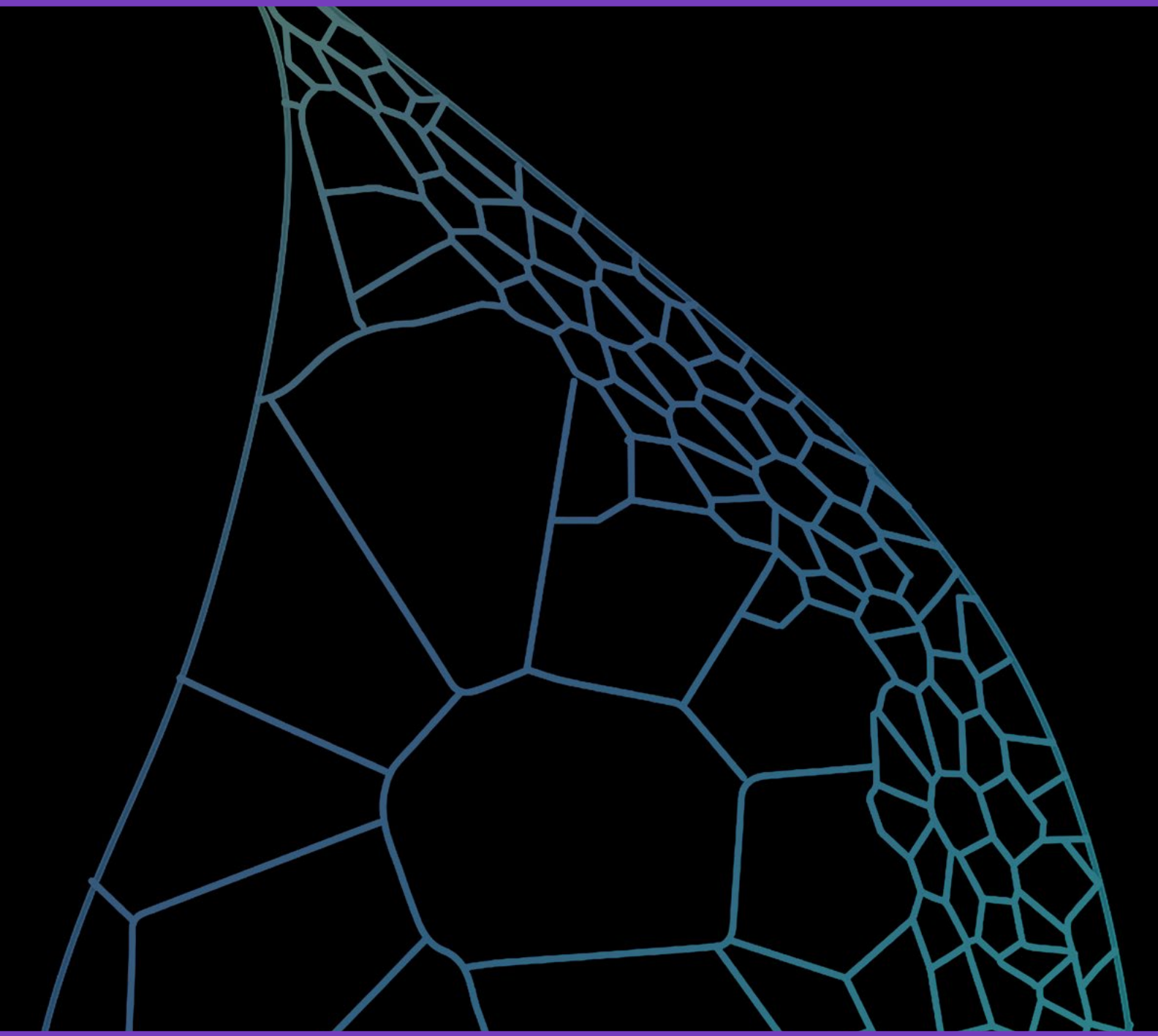

A YEAR ON THE HILL: 2020 Congressional Fellow Perspective

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JOM

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About the Cover

Shown is a schematic of a cold spray deposited particle showing the grain refinement due to severe deformation and subsequent recrystallization at the point of contact, accompanied by material jetting at the circumference. The degree of plastic deformation lessens from the impact surface to the center of the particle, creating a gradient in grain size through the particle cross section. Cold spray is one of the solid-state additive manufacturing methods that rely on material bonding through mechanical deformation discussed in "Solid-state Metal Additive Manufacturing: A Review" by Nihan Tuncer and Animesh Bose of Desktop Metal Inc.

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Peeyush Nandwana, Oak Ridge National Laboratory
Matthew Dunstan, U.S. Army Research Laboratory
James Paramore, U.S. Army Research Laboratory
Kathy Lu, Virginia Polytechnic Institute and State University

Materials Research in Reduced Gravity
Process Technology and Modeling Committee; Solidification Committee
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Jonghyun Lee, Iowa State University
Shaun McFadden, Ulster University

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Shawn Coleman, CCDC Army Research Laboratory
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Jacob Bair, Pacific Northwest National Laboratory
Sugata Chowdhury, National Institute of Standards and Technology

Thermodynamic Modeling of Sustainable Non-Ferrous Metals Production: Part II
Process Technology and Modeling Committee; Recycling and Environmental Technologies Committee
Fiseha Tesfaye, Abo Akademi University
Alexandra Anderson, Gopher Resource
Mingming Zhang, ArcelorMittal Global R&D

About JOM:

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

About TMS:

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

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in the final analysis

JOM
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"It's a competitive world, everything counts in large amounts."

— Depeche Mode, "Everything Counts"

Be it as a student or a professional, one constant in my life is that I generally have music playing as an accompaniment during work and at leisure. In the office, I keep it politely low, of course, but it's always there helping me along. During my "adulting" period in the 1980s when I came to work for TMS, the background soundtrack of my life was rich with the tasty post-punk pop-rock called "New Wave." Depeche Mode is a fine exemplar of this genre. (Do yourself a favor: Tell your smart speaker, "Play 'Enjoy the Silence' by Depeche Mode.") My early days with the Society were especially focused on *JOM*. As I checked to see if equations balanced and considered the internal consistency in tables and graphs within our papers, the lyric on the radio would remind me that everything counts in large amounts . . . and the voice inside my head would add, "in small amounts, too."

Beyond the numbers reported in the journal, we naturally wanted to collect and understand numbers *about* the journal. Did the readers appreciate what we published? What was being read? What topics generated the most interest? The same questions still apply today, but the methods toward improving our understanding have changed considerably.

Back in the pre-Internet and pre-Excel days, our efforts entailed mailing photocopies of each month's table of contents to selected readers and stakeholders. We would ask them to rate each article on a scale of 1 (poor) to 5 (excellent) and then mail the photocopy back to us for tabulation. A few months and some pencil-and-eraser time later, we would typically find that the per paper average fell in the 3.5–4.5 range. Pretty good. In the 1990s, we took a quantum leap and switched our focus from photocopied mailings to reviewing journal Impact Factor ratings. In those olden times, the *JOM's* Impact Factor was around 0.5. Today, it sits at a respectable 2.029. Impact Factor very much matters to researchers and publishers, but in more recent years we complement this by looking at download statistics as well. Every paper published by *JOM* resides on the SpringerLink website and every download is counted. TMS members get all of this content at no cost. For the first half of 2020, here are the most-downloaded papers:

2013: "Lithium: Sources, Production, Uses, and Recovery Outlook," by Laura Talens Peiró et al. (4,190 downloads)

2016: "Current and Prospective Li-Ion Battery Recycling and Recovery Processes," by Joseph Heelan et al. (2,746)

2016: "Materials Selection in Gas Turbine Engine Design and the Role of Low Thermal Expansion Materials," by Benjamin W. Lagow (2,142)

2017: "Review of the Methods for Production of Spherical Ti and Ti Alloy Powder," by Pei Sun et al. (2,076)

2017: "Toward Low-Cost, High-Energy Density, and High-Power Density Lithium-Ion Batteries," by Jianlin Li et al. (1,818)

We've not yet reached the finish line in our assessment culture; we are only getting started as we begin to leverage the big data era. Qualitative and quantitative analysis for research papers has gone multidimensional thanks to tools like those that you can access on the SpringerLink site. You can easily view the metrics on your papers and those of your colleagues as SpringerLink has added a "metrics" link to every *JOM* paper. Click and see how many times each one has been accessed, who has cited it, and even who has tweeted about it. I think it an excellent addition to an excellent web resource that provides considerable value to TMS members and the materials community. I like it!

Ultimately, the counting is great, but the understanding of what is being counted is so much, much better.

James J. Robinson
Executive Director
@JJRofTMS

"Impact Factor very much matters to researchers and publishers, but in more recent years we complement this by looking at download statistics as well."

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In Case You Missed It:

Business News from the Field

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

Porsche Prints Auto Parts

Stuttgart, Germany: Porsche AG, in partnership with suppliers Mahle GmbH and The Trumpf Group, produced high-performance aluminum pistons with a 3D printer. Mahle's high-purity metal powder supplied a Trumpf printer that used laser beams to melt the powder one layer at a time. Conducted as a development exercise, the demonstration offers a new method of manufacturing engine parts that will operate under intense pressure and heat. The pistons, designed for Porsche's 911 GT2 RS model, are lighter and stiffer than the traditional part and have an integrated and closed cooling system that results in increased power and efficiency.

Startup Offers Germ-Killing Phone Case

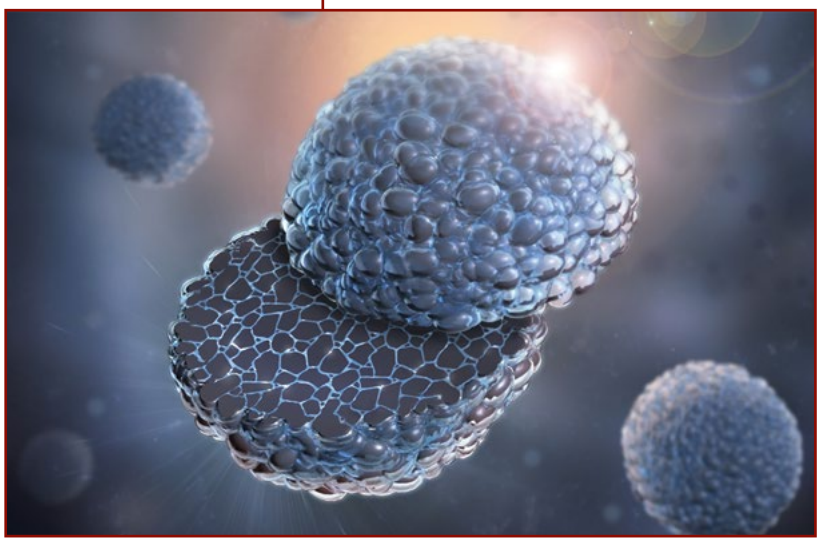
Nashville, Tennessee, USA: Aeris Copper began selling a cell phone case that is designed for medical personnel and uses copper to kill microbes, including coronavirus. The startup touts a patent-pending coating process to remove copper's electrical conductivity that would otherwise interrupt the phone's cellular signal. The case material is over 70% copper by weight, a concentration high enough to employ copper's natural germ-killing properties. New uses of copper, such as in medical supplies, face masks, and the Aeris phone case, are trending with the global need for anti-microbial products.

SMS Acquires Brazilian Tech Companies

Duesseldorf, Germany: SMS Group GmbH will acquire and merge two Brazilian industrial technology companies Viridis Energy Solutions and Vetta Technologies. The newly formed company, Vetta Tecnologia SA, will emphasize efficiency and sustainability technologies and create a competency center for industrial digitalization in Latin America. Through the transaction, SMS Group will hold a majority stake in the new business, which will be managed by the founders of Vetta and Virdis. The new business will add energy and sustainability services to SMS Group's digital portfolio.

Cobalt Prospectors Apply Data Science

San Francisco, California, USA: Kobold Metals gained rights to about 1,000 square kilometers in northern Quebec and plans to harness big data to explore an area rated "highly prospective" for cobalt, nickel, and platinum-group metals. The San Francisco Bay Area-based startup employs an approach to data analysis that has been called "Google Maps for the earth's crust." Shareholders of Kobold Metals include Silicon Valley venture capital firm Andreessen Horowitz, Norwegian energy company Equinor ASA, and Breakthrough Energy Ventures, along with business magnates Jeff Bezos, Michael Bloomberg, Ray Dalio, and Bill Gates.



Lemont, Illinois, USA: Researchers at the U.S. Department of Energy's Argonne National Laboratory in collaboration with scientists at Hong Kong University of Science and Technology have developed a particle-level cathode coating for lithium-ion batteries that will extend their battery life and increase safety for consumers. With the polymer coating made from poly(3,4-ethylenedioxythiophene) (PEDOT), the cathode is completely protected from oxidation that that can occur after operating at a high voltage. Batteries can operate at 4.6 V at the cell level, compared to 4.2 V of today's batteries, and bring significant cost savings for manufacturers, as well as consumers. (Image courtesy of Argonne National Laboratory.)

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Impact Factors and Other Key Metrics Released for All Six TMS Journals

Matt Baker and Kelly Zappas

"This year's release marks the first Impact Factors for *Integrating Materials and Manufacturing Innovation* (*IMMI*) and *Journal of Sustainable Metallurgy* (*JSM*), both of which achieved strong debut numbers."

The 2019 Journal Citation Reports (Clarivate Analytics, 2020) were released in late June and included Impact Factors for all six TMS journals. This year's release marks the first Impact Factors for *Integrating Materials and Manufacturing Innovation* (*IMMI*) and *Journal of Sustainable Metallurgy* (*JSM*), both of which achieved strong debut numbers. The following list shows the 2019 Impact Factors for each TMS journal, with a comparison to 2018 in parentheses for journals that received an Impact Factor for that year:

- *Integrating Materials and Manufacturing Innovation*: 3.447 (n/a)
- *JOM*: 2.029 (2.305)
- *Journal of Electronic Materials*: 1.774 (1.676)
- *Journal of Sustainable Metallurgy*: 2.109 (n/a)
- *Metallurgical and Materials Transactions A*: 2.05 (1.985)
- *Metallurgical and Materials Transactions B*: 2.035 (1.952)

The success of TMS's two newest journals reflects the changing landscape of materials science and engineering, according to Judy Schneider, TMS Director/Chair, Content Development & Dissemination and Professor, University of Alabama at Huntsville.

"*IMMI* explores innovations that build on integrated computational materials engineering (ICME), from the discovery of materials through their manufacture," said Schneider. "The journal reflects the convergence of several research fields toward the goal of accelerating discovery through multi- and interdisciplinary research areas. A complement to accelerated discovery is the consideration of sustainability of metal-producing industries, with an emphasis on materials recovery, reuse, and recycling. For these efforts, *JSM* captures the emerging research."

A journal's 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. Impact Factor is just one of many factors to consider when evaluating journal performance. The Impact Factor is a measure of the impact of a journal, and not of the quality of the published research.

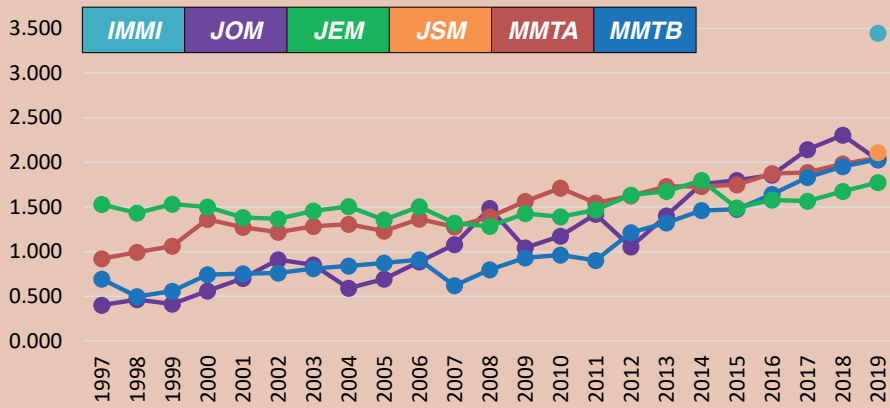

Figure 1. Impact Factors for TMS journals since 1997.

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

Table II shows a more comprehensive overview of 2019 key metrics across the entire TMS journal portfolio. It is worth noting that *Metallurgical and Materials Transactions A* had the most total citations (30,270) and the most total downloads (934,975) among TMS journals.

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

Category Name	2019 Total Journals	IMMI	JOM	JEM	JSM	MMTA	MMTB
Materials Science, Multidisciplinary	314	112	192	216	-	188	190
Metallurgy & Metallurgical Engineering	79	-	23	-	19	21	22
Mineralogy	30	-	12	-	-	-	-
Mining & Mineral Processing	21	-	8	-	-	-	-
Engineering, Electrical & Electronic	266	-	-	157	-	-	-
Physics, Applied	154	-	-	92	-	-	-
Green & Sustainable Science & Technology	41	-	-	-	30	-	-
Engineering, Manufacturing	50	17	-	-	-	-	-

Table II. This table shows 2019 key metrics—five-year Impact Factor, total citations, and total downloads—for TMS journals in addition to their Impact Factors.

	IMMI	JOM	JEM	JSM	MMTA	MMTB
2019 Impact Factor	3.447	2.029	1.774	2.109	2.05	2.035
Five-Year Impact Factor	-	2.717	1.619	-	2.244	2.248
Total Cites 2019	479	10,345	12,786	551	30,270	9,636
Total Downloads 2019	61,609	636,629	306,836	82,223	934,975	368,346

To access TMS's entire library of journals, visit the Journals section of the TMS website at www.tms.org/Journals. (TMS members should log in to the TMS website before clicking on the individual journal links to ensure full access to content.)

Visit the journal home pages on the Springer website (accessible through the TMS Journals website) to view a range of 2019 key metrics including Impact Factors.

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Three Lessons and A Question: Experiencing the Year 2020 on Capitol Hill

Alexander Martin

A group of Congressional Fellows, including TMS/MRS Fellow Alexander Martin, pause for a photo in front of the U.S. Capitol building.

Alexander Martin

For the past year, I have had the honor of participating in the most rewarding professional experience of my life, serving as the 2019–2020 TMS/MRS Congressional Science and Engineering Fellow during an unusual and difficult time in our country's history. Between the COVID-19 global pandemic and the looming threat of climate change, the year 2020 has made it clearer than ever that the federal government must recommit to listening to our nation's experts in academia, industry, and government about the growing threats that we face as a nation. The Congressional fellowships offer a valuable avenue for policymakers to receive in-house scientific counsel, while also helping scientists develop an understanding of the political landscape that serves as the backdrop for policy debate around scientific issues like climate change.

During my year on the Hill, I have had the pleasure of working for U.S. Senator Brian Schatz of Hawaii, serving alongside an excellent and committed group of staffers focused on climate, energy, and environment issues. Along the way, I have learned how to adapt to a very different working environment that includes different expectations, work products, communication styles, and goals. A few lessons that I've learned along the way are presented here.

Lesson 1: Five Minutes or One Page

Being an effective staffer means providing direct, insightful, and brief communication, especially when talking

Are You the Next TMS/MRS Congressional Fellow?

TMS and the Materials Research Society (MRS) are now accepting applications for the 2021–2022 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. Applicants are expected to be a member of or applicant for membership of TMS or MRS and must have a Ph.D. by September 1, 2021. U.S. citizenship is not required, but applicants must be authorized to work in the United States.

Applications are due on the first Friday in January. For additional information on the fellowship, contact Mary Samsa, TMS Foundation and Public Affairs Manager, at msamsa@tms.org.

Martin in the Hart Senate Office Building in Washington, D.C., for some casual weekend work.

(or writing) to your boss. For members of Congress time is precious, and staff often need to communicate a large amount of information in a few words. To do this, you constantly fly over topics at 30,000 feet, looking for landmarks on the ground to guide you in the right direction.

Imagine distilling your 300-page thesis into one page, or the collective knowledge of an entire field of expertise into five minutes. Nobody can be an expert at everything, but as a scientist, you have honed your skills at determining which sources and statistics you can trust, and that comes in handy.

Martin (back row, second from left) with other Congressional and Executive Branch Science and Policy Fellows.

Though my Ph.D. taught me to be thorough, I've learned that on the Hill, five minutes (or one page) is often all the time (or space) you need to help your boss make an important decision. Lead with the answer, justify your decision with key insights and information, and use simple language. Rely on the consensus of experts and organizations of experts when you're short on time. Make it easy for your boss to decide how to proceed.

Lesson 2: May I Have Your Attention, Please

Even during more normal years on the Hill, progress can be slow and unpredictable. While the Senate floor has well established rules and procedures, legislative to-do lists are always subject to the whims of politics and circumstance. So far, the 116th U.S. Congress has not followed the script.

Between the impeachment of the President, the COVID-19 global pandemic, and the national Black Lives Matter movement and protests, the focus of Congress has needed to shift quickly in response to changing national priorities. Though 2020 will go down in history as a particularly strange and turbulent year, the nature of working in politics means you are always listening for feedback from your constituents, reassessing your priorities, readjusting your expectations, and redefining success. When new tasks pop up with short deadlines, a staffer needs to be able to shift their focus quickly and recognize the changing landscape of priorities for their office and their constituents.

Lesson 3: A Common Set of Facts

The last decade has been a challenging and disconcerting time in politics for many scientists, economists, and medical professionals. With so many voices vying for attention, claiming equal credibility, scientists need to continue to speak up for the importance of scientific consensus and insist on data-driven policy making.

The ultimate value-add of engaged scientists is their ability to establish a common set of facts to underpin policy

Meet the 2020–2021 Congressional Fellow

Megan Malara

Megan Malara of The Ohio State University has been named the 2020–2021 TMS/MRS Congressional Science and Engineering Fellow. Malara is a member of the Material Advantage student program sponsored by TMS and three partner materials societies. As a Fellow, she will serve a one-year term working as a special legislative assistant on the staff of a member of Congress or congressional committee.

Malara's interest in science policy began while attending Material Advantage Congressional Visit Days where she connected with the offices of elected officials and offered her experience as a scientist. She continued her interest in policy as a community team leader for a political campaign where she trained and organized volunteers to engage with the public on policy-related issues. Influenced by her Rust Belt upbringing, Malara has policy interests in translating research to manufacturing jobs, increasing opportunities for education, and improving public confidence in science.

"During the fellowship year, I look forward to gaining further insight into the role of scientists in policy, and actively engaging in the legislative process," Malara said. "As we find our way through the current health crisis, I aim to lend my technical background in biology and biomaterials to meet the legislative challenges to come."

Malara earned her B.S. (2014) and Ph.D. (2020) degrees in materials science and engineering from The Ohio State University. She began her specialization in biomaterials with research pertaining to nanoscale polymeric fibers as a platform to sort cancer cells and as a 3D scaffolding for small diameter blood vessels. Malara conducted her graduate research in tissue engineering and regenerative medicine. Her doctoral research focused on developing the dermal-epidermal junction (DEJ) of cultured skin grafts for the treatment of large total body surface area burns. Using techniques such as photolithography and laser ablation to pattern scaffold surfaces to mimic the native DEJ, Malara conducted in vitro analyses of cell behavior to patterning and in vivo animal studies to translate this technology towards clinical application.

Malara will begin her 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 she will choose the office in which to spend her fellowship year. For more information on the program, visit www.tms.org/PGA and click the link for TMS/MRS Congressional Science and Engineering Fellowship.

debates. When we can all agree on a common set of facts, political debate is distilled down to its core, representing a difference of value-based judgments and goals for society. And when the scientific consensus of anthropogenic climate change is accepted by the right and the left, as it now seems to be, we can start discussing solutions that mitigate the threat while also protecting American workers and the economy.

And Finally, A Question: If You Are Dissatisfied with U.S. Science Policy, You Have the Power and the Expertise to Join the Debate and We Need Your Help. So, How Will You Engage?

The U.S. needs all types of engagement in science policy and politics. Maybe you can consider how your research touches on a science policy topic and start including that analysis in your publications or in complementary media. Maybe you can coordinate citizen science efforts to uncover new insights, achieve better policy outcomes, and help build up the public's trust in science by making it more accessible. Maybe you can call or visit your local representative and tell them how they are getting the science wrong and offer to help them and their staff sort out the details. Maybe you can accept a leadership role at your university or company and make sure the world is hearing your organization's perspective, informed by your collective expertise.

Or maybe you could be the next TMS/MRS Congressional Fellow. Now more than ever, the U.S. needs experts to engage in policy and politics, and materials scientists are welcome and needed to inform the debate.

Alexander Martin is the 2019–2020 TMS/MRS Congressional Science and Engineering Fellow.

"Now more than ever, the U.S. needs experts to engage in policy and politics, and materials scientists are welcome and needed to inform the debate."

—Alexander Martin

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Highlighting Best Practices in Promoting Diversity, Inclusion, and Civility in STEM

Jenifer S. (Warner) Locke

Jenifer Locke

"Highlighting Best Practices in Promoting Diversity, Inclusion, and Civility in STEM" serves as in introduction to a thematic group of articles in the September 2020 issue of *JOM* covering diversity and inclusion topics. The article package is a feature series developed by the TMS Diversity, Equity, and Inclusion Committee. For additional information, contact Kaitlin Calva, *JOM* Magazine Managing Editor, at kcalva@tms.org.

I think all people who are underrepresented in their career field, be it because of gender, race, LGBTQ+, religious orientation, country of origin, disability status, etc., will share a common experience of knowing something should be done better, but not really knowing how. This feeling of uncertainty, of only knowing that how something is currently done isn't working for a specific group of people, can halt our ability to speak for ourselves and others. I personally find this to be particularly true for data- and fact-driven people, like the scientists and engineers who make up the TMS membership. We have a feeling, but don't have facts and examples to show a different path forward, so we remain silent. The goal of this special article series from the TMS Diversity, Equity, and Inclusion Committee is to provide us all with some data and best practices on efforts occurring within our communities to improve representation and retention of minorities in STEM. It is my hope that the following four articles can provide data and facts to propel *JOM* readers' voices and help them enact change in their workplaces and communities.

The first article, written by Teri Reed et al., addresses the need to end harassment in our workplaces and communities. In this article you will learn about civility audits and results, find what gaps exists in these surveys and steps the authors are taking to fill these gaps, and read the promising practices these researchers have found over the past years.

Next, Aeriel Murphy-Leonard details how a group of graduate students has taken outreach to the next level through the Liberian Society for Women Engineers SUCCESS Camp to increase the representation of women in engineering in Liberia. This article will inspire you to broaden your thinking on approaches to increasing representation.

The third article, written by Mary Juhas and Caroline Crisafulli, outlines a successful initiative called REACH for Commercialization that works to strategically address and repair the gender gap in commercialization, translating research to startup success, and patenting. As this program expands outside of its local community, its increased visibility can provide readers with a tool to infuse their inventions and startups with fresh and diverse ideas.

The last article, by Whitney Gaskins et al., focuses on successful efforts taken by The Gaskins Foundation at all levels of K–12 education to increase representation of underrepresented minorities, particularly Black and Latinx, in STEM. The Foundation's work shows that individualizing approaches to specific age groups and targeting the needs of the whole person are translating into real success. This article makes connections with a growing foundation that can help create a best practice outreach program in your own community.

While the enclosed highlight just a few of the best practices, we know there is more being done and so much more to do. As we are all seeing and voicing our support for the rise of Civil Rights movements, like Black Lives Matter, I hope these articles provide a starting place for having those tough conversations or identifying a path to success.

Jenifer S. Locke is an assistant professor in the Department of Materials Science and Engineering and the Fontana Corrosion Center at The Ohio State University. As a TMS member, she is actively involved in the Diversity, Equity, and Inclusion (DEI) Committee, for which she curated this article series. **Locke would like to thank the DEI committee members and the authors featured in this article series for their work in putting together this special topic.**

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Towards Civility: Efforts to Address Harassing Behaviors in Engineering

Teri K. Reed, Teri J. Murphy, Cijy Elizabeth Sunny, Whitney Gaskins, and Ashley Paz y Puente

In 2018, the National Academies of Sciences, Engineering, and Medicine (NASEM) published the report, *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine*.[1] As with other NASEM consensus studies, the report provides a state-of-the-art synthesis and evaluation of the knowledge base and offers recommendations both for practice and for further research. The report categorizes sexually harassing behaviors into:

1. Gender harassment (verbal and nonverbal behaviors that convey hostility, objectification, exclusion, or second-class status about members of one gender);
2. Unwanted sexual attention (verbal or physical unwelcome sexual advances, which can include assault); and
3. Sexual coercion (when favorable professional or educational treatment is conditioned on sexual activity).[1]

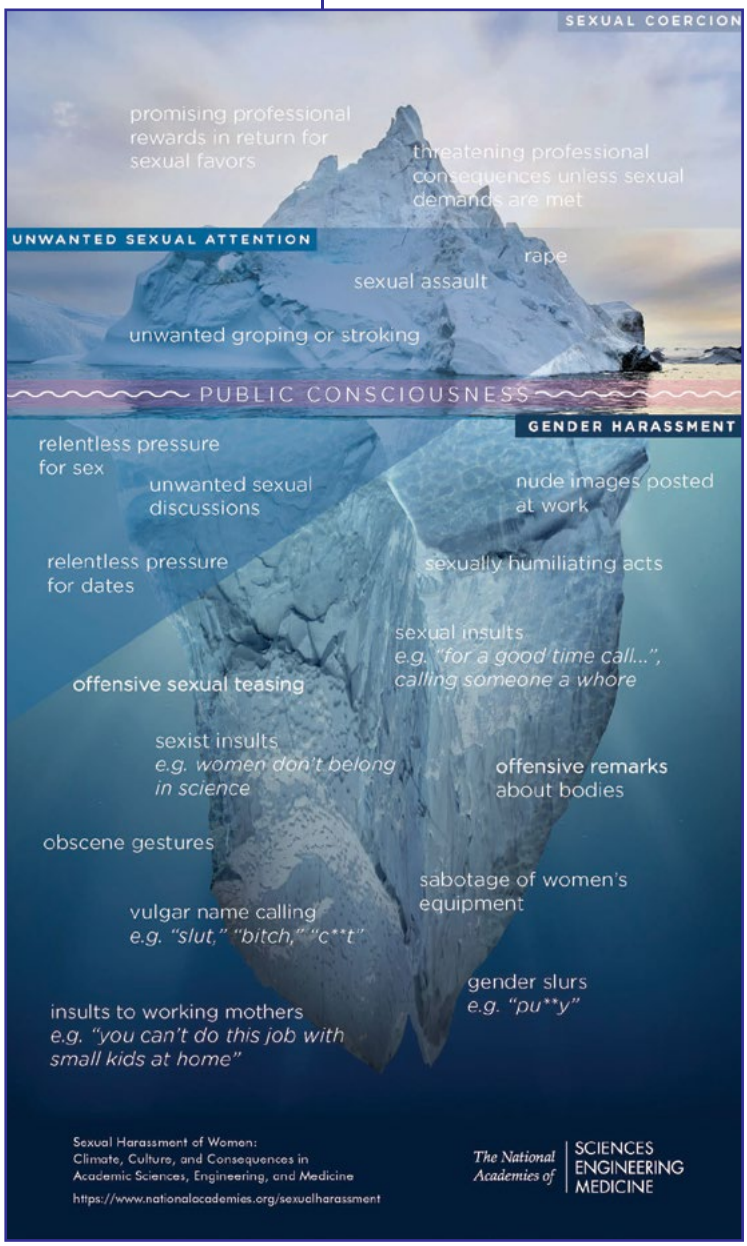

Figure 1. The public consciousness of sexual harassment and specific sexually harassing behaviors.[1]

As illustrated in Figure 1 (often referred to as the Iceberg Model), sexual coercion and unwanted sexual attention are more visible in the public awareness, but gender harassment is actually the most prevalent of the three categories. Evidence presented in the report reveals that academia is second only to the military in prevalence of sexually harassing behaviors (58% vs. 69%) and that within academia, engineering is second only to medicine (25% vs. 45%).[1] Although the NASEM report focuses on academia, a related body of research indicates that "women's accounts of internships and summer jobs differ from that of men. They describe a culture that is isolating, that often assumes women are second-class experts, and where sexism is normative."[2]

A team in the College of Engineering & Applied Science (CEAS) at the University of Cincinnati (UC) has been working from several directions to replace harassing behaviors with civility: fundamental research, promising practices for training, and continued commitment to action through institutional membership in a NASEM action collaborative.

Fundamental Research

Focus on Experiential Learning: As the founder of co-op more than 100 years ago, UC has a long and rich history of engaging students in co-op and other experiential learning

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opportunities, which positions us to pay special attention to student experiences in these settings and the impact of those experiences. Thus, in our research, we distinguish between classroom settings (i.e., an environment in a formal learning setting, including labs and field trips, with multiple students and an instructor[s]) and experiential learning settings (e.g., co-op, study abroad, undergraduate research, service learning).

Preliminary Results: In the initial (current) phase of our mixed-methods research design, we adapted the Administrator Researcher Campus Climate Collaborative (ARC3) survey into an instrument that we have called the UC Civility Audit.[3–4] Of particular note, we added a module focused on encounters in experiential learning settings. The UC Civility Audit 2020, completed by 112 undergraduate engineering students, provides initial baseline prevalence estimates and informs subsequent phases of the research. This response sample is overrepresented in female students and students from racial/ethnic populations underrepresented in engineering (e.g., Black, Latinx, Native American). Preliminary survey results indicate that of the 23 who experienced sexist or sexually offensive language, gestures, or pictures (which are forms of gender harassment) in experiential learning settings, 19 were female and four were male. Examples of comments shared by participants in open-ended items include:

- "made sexual comments about women in general and loose remarks about me and other women at the company" (fifth-year, mechanical engineer)
- "I just don't like people asking me if I'm gay or not" (first-year, computer science)
- "a snide remark was made regarding if I knew what I was doing because I was working with tools" (third-year, biomedical engineer)
- "especially in construction, engineering, and more dominated fields, women have to deal with more degrading comments" (fourth-year, civil engineer)

Responses indicated that the majority of these behaviors (13 of the 23) came from a colleague or coworker. As described by one participant: "During my first co-op, a coworker repeatedly made harassing comments and jokes about me and towards me daily for a month until I told him to stop. The comments became less frequent after that, but they were still made" (second-year, chemical engineer).

What's Next: Gaps in the Data: The NASEM report and other resources (including our own experience with the UC Civility Audit 2020) identify a number of challenges in determining prevalence estimates:[1]

- Response rates to climate surveys are low.
- Response rates from individuals who identify as underrepresented and/or LGBTQ+ are even lower.
- The low response rates also mean that intersectionality is difficult to study.
- Data from climate surveys are rarely disaggregated sufficiently to examine discipline-specific issues.

The next phases of our research design will address some of these challenges. Specifically, we will conduct a group level assessment (GLA), which will help us translate the needs and priorities of stakeholders (e.g., industry, students, professors, university administration) into the design and implementation of interventions. Then, combined results from the UC Civility Audit 2020 and the GLA will inform phenomenological studies that use interviews and focus groups to develop deeper understandings of both shared and individual experiences.

Promising Practices for Training

Faculty/Staff: Each new cohort of faculty, joining CEAS in any one fiscal year, participate in orientations that cover many topics, including culture in the classroom/lab. While this training includes topics such as being a mandatory reporter for Title IX, it also covers bystander interventions. Using role play, each faculty is paired with a peer, alternating playing the roles of student and faculty, to go through scenarios from known incidents. Role play is an active learning technique that simulates reality

in an environment in which negative effects are minimized and confidence to respond increases.

Students: In August 2018, the UC Department of Engineering Education conducted a two-day orientation for ~60 students (graduate and undergraduate) preparing to serve as teaching assistants for the Introduction to Engineering Design Thinking course (taken by ~1,400 first-year engineering majors). In addition to the two hours of Title IX and Clery Act training required for compliance, the orientation included a three-hour session on diversity, equity, and inclusion and a 90-minute session on bystander intervention. The bystander intervention training, which was conducted by the assistant director for the UC Student Wellness Center, focused on bystander intervention in the classroom (versus, for example, at a party). Modifications of this session were included for subsequent cohorts of teaching assistants either during the orientation or as part of the weekly teaching team meetings throughout the semester.

What's Next: Upstander Intervention Training: What separates a bystander from an upstander is the response behaviors of a witness to a harassing behavior situation involving perpetrator(s) and target(s). An upstander is moved to action both in an individual (courageous, action-oriented, assertive, compassionate, and leader) and collective (part of a community, relationship to others in this community, responsibility, partnership opportunities, and shared concerns) perspective. As emphasized in a training offered by the National Institutes of Health, evolving from bystander to upstander means engaging to diffuse a situation, interrupt the situation, and keep a record of the event as evidence.[5]

Continued Commitment to Action through Institutional Membership in a NASEM Action Collaborative

In 2019, UC became an institutional member of the NASEM Action Collaborative on Preventing Sexual Harassment in Higher Education. The university's internal working group structure will parallel the structure developed by NASEM: data/evaluation (measuring climate and gauging progress on campus); prevention (initiatives to prevent harassment); response (responding to harassment when it occurs); and remediation (limiting the damage caused by sexual harassment). The NASEM report includes 15 recommendations for institutions of higher education and funding agencies.[1] In line with a number of these recommendations, our work is intended, long-term, to determine and track the prevalence and nature of harassing behaviors in engineering, especially gender harassment; implement promising practices for the prevention of harassing behaviors; and institutionalize a culture of civility and respect.

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Lessons from Liberia: Building Global Partnerships Through Materials Science Outreach

Aeriel D. Murphy-Leonard

Aeriel Murphy-Leonard

Introduction

"The future depends on what we do in the present," as the great Mahatma Gandhi once said. Similar to Gandhi, I too believe the access we provide to science and engineering resources in the present will shape global policies, inventions, and technology in the future. Though Africa has the richest reserves of metals and minerals in the world, there are only six accredited, college-level materials science/metallurgy programs on the entire continent, while the United States has more than 100 programs at colleges in every part of the country. Unfortunately, while being a global leader in the extraction and export of minerals and metals, Africa has, to date, provided few contributions to technological advances and scientific innovations in the field. Many students in Africa are unable to access university-level opportunities in materials science due to geographic constraints compounded by economic barriers. These disparities lead to a global deficit of talent and loss of potential innovations in materials science. It is my main goal and passion to create a pipeline to materials science for students on the continent of Africa, specifically in West Africa.

Liberia is a small, West African country overlooking the Atlantic Ocean with very close ties to the U.S. In the early 1800s, the American Colonization Society created a settlement of freed African American slaves on the continent of Africa in a region now known as Liberia. From that moment on, Liberia reigned as one of the wealthiest and most prosperous African countries. However, more recently, a 14-year civil war and the Ebola outbreak of 2014 have decimated the country.

Motivation and Goals of the L-SWE SUCCESS Camp

The Liberian education system has suffered greatly from long periods of civil unrest compounded by school closures due to Ebola. These issues, coupled with strong cultural beliefs that encourage families to invest in the education of young boys at the expense of young girls, have left very few women in the pipeline to collegiate success. In fact, women account for less than 10% of the engineering student population at the University of Liberia. An exploratory study performed by the University of Michigan Chapter of the Graduate Society of Women Engineers (UM Grad-SWE) at the University of Liberia revealed that a major threat to the retention and success of women in engineering was the lack of a supportive network. This, along with gender-based discrimination, creates a hostile and unfriendly classroom environment for female students. With this knowledge, UM Grad-SWE and female engineering students in Liberia founded the Liberian Society of Women Engineers (L-SWE) to create a peer-supported community among female engineering students in Liberia. The peer-to-peer partnership between SWE at the University of Michigan and L-SWE is a mutually beneficial collaboration that allows both groups to gain unique cross-cultural experiences and create an international network of female engineers. The first outcome of this partnership was the creation of the leadership camp Setting Up Collegiates for Careers in Engineering through Social Support (L-SWE SUCCESS), first implemented in 2015 in Monrovia, Liberia.

The SUCCESS camp is a two-week long, residential leadership camp focused on developing skills in science, technology, engineering, and mathematics

(STEM) for female engineering students in Liberia. The goals of the camp are two-fold: (i) to provide American and Liberian female engineers with the skills and support necessary for becoming successful engineering professionals; and (ii) to strengthen the community of female engineers in the U.S. and Liberia by building cross-cultural partnerships among female engineering students resulting in a global network of women engineers. In the first week, the curriculum is focused on professional development with workshops on the graduate school application process, preparing resumes, writing personal statements, and presentations from engineering companies in Liberia. These sessions are designed and taught by the UM graduate students. The second week focuses on developing skills in STEM through various hands-on lessons as well as sessions on leadership. During this week, sessions and workshops are led by both UM and L-SWE students. The SUCCESS camp is now in its sixth iteration.

Best Practices and Lessons Learned from International Outreach

From my experience, there were three specific strategies that were crucial in ensuring the effectiveness of the SUCCESS camp:

1. Build Partnerships Not Relationships

When working with international communities, it is important to build partnerships. Partnerships involve a long-term, mutually beneficial commitment where each group contributes to the success of the other. These partnerships with local leaders, organizations, or institutions are important for building trust in the community and are key to the success of the program. The time differences, language barriers, and cultural differences make it difficult to communicate with the community effectively and these partnerships enable inroads into different communities. From my experience, this is the most important and challenging aspect of the process because it requires an investment of time, planning, and resources beyond what is usually required for domestic outreach.

"These partnerships with local leaders, organizations, or institutions are important for building trust in the community and are key to the success of the program."
—Aeriel D. Murphy-Leonard

These partnerships were important for recruiting students for the SUCCESS camp. In Liberia, it is taboo for young women to stay away from home and is only allowed with trusted family members. Through partnerships with L-SWE, the University of Liberia, and other community leaders, we were able to nurture relationships with parents and guardians through in-person meetings, video calls, and social media. There are several things to consider when developing local partnerships, including:

- Identify organizations and/or people who have access to communities you are looking to serve.
- Nurture partnerships with local organizations, community leaders, and institutions with respect and consistent communication.
- Engage with community members about the expected cultural barriers, available resources, and needs of the community. Do not pretend to be an expert.
- Clearly communicate the purpose, goals, and possible outcomes for participants with the local community members. Trust is key.

2. Think Long-Term When Designing the Outreach Program

It is imperative to develop a program or curriculum from the perspective of how it affects the community in the long-term. For the SUCCESS camp, through our exploratory study, conversations with professors and students, and pre- and post-camp surveys, we had a clear

"It is imperative to develop a program or curriculum from the perspective of how it affects the community in the long-term."
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understanding of students' expectations and outcomes of the camp. With this information, we designed a curriculum that was relevant and beneficial to the long-term success of the participants that utilized our particular skills and knowledge including the following:

- Understand what information participants want to learn versus what they already know. This can be gleaned through surveys, in-person meetings with potential participants months before the outreach program, and conversations with local educators.
- Create a challenging curriculum. Do not underestimate student abilities.
- Flexibility is important. Plan breaks between sessions. Be prepared for power/water outages.
- Be prepared for university schedule changes. For example, the SUCCESS camp starts at the end of the final exam schedule. In most cases we have students who need to leave during the camp for finals and/or meetings with administrators.
- Know what local resources are available (i.e., computers, materials, space/classrooms).
- Choose activities the participants can use for local K–12 outreach. Remember the pipeline is the most important outcome of the outreach program.

3. Teaching Materials Science in Liberia

The field of materials science is very important in Liberia with iron and rubber being two of its main exports. Many of the camp participants are studying geology or mining engineering and have a basic understanding of materials science concepts.

As a materials scientist, my main goal was to develop an MSE curriculum that both expanded and extended beyond the student's prior knowledge. The first strategy was to gain an understanding of what students were learning in-class and what critical information was missing from the curriculum. Through conversations with professors and class syllabi provided, I knew that the lack of application-based learning and laboratories were key barriers for both students and professors. Using this information, I developed materials science experiments based on what students were currently learning in class. These projects ranged from innovative ways to use shape memory alloys to solve infrastructure problems in Liberia to designing reinforced concrete for crack-resistance.

Conclusion

Across the continent of Africa, college programs in materials science are sparse and unattainable for the majority of citizens. These challenges pose a grave threat to the future and sustainability of our field. Professional societies and organizations in MSE have the potential to use their position to lobby companies and institutions to recruit and invest in exceptional engineering talent across Africa. Through global partnerships with institutions such as the Joint Undertaking for an African Materials Institute and local universities, we can develop the next generation of materials scientists and engineers. Diversity is more than the race or ethnicity of the people in the room. Diversity also comes from the unique experiences and journeys of all people in the room. When these experiences come together, we can build innovative solutions for global impact. My experience in Liberia taught me that every human regardless of race, sex, or class deserves the best opportunity to succeed in whatever they choose.

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REACH for Commercialization: Narrowing the Gender Gap in Technology Transfer

Mary C. Juhas and Caroline E. Crisafulli

Mary C. Juhas

Caroline E. Crisafulli

Background

A 2019 U.S. Patent and Trademark Office report revealed that over the last decade, all-female teams on patents represented roughly 4% of issued patents.[1] As shown in Table I, there is a persistent and wide gender gap in patent activity across all economic sectors including corporations, academia, government, and nonprofits. The greatest disparity is found in the corporate sector. While the patents with at least one female inventor have increased from 4% in 1976 to 21% in 2016, the number of unique women inventors (considering those with multiple patents), shown as "women inventor rate," has remained flat at about 10–12% since 2000.

Research reveals that this imbalance stems predominantly from 1) inadequate formal and informal networks, and 2) the "service tax," which disproportionately disadvantages women with extra work burdens that routinely go unrecognized and uncompensated.[2–3] This is particularly true for women of color who experience the service tax double bind. These realities of the job are exacerbated by deeply entrenched cultural norms that are typically unspoken but have significant impact. Women are uncomfortable with the self-promotion necessary to stand out and move ideas forward. Those who do risk engaging in self-promoting behavior earn unflattering labels, sometimes from other women. Women often avoid the risk of representing their gender if they fail. This is especially the case when they engage in professional activities perceived as straying outside the established expectations and requirements of their job. Indeed, invention disclosures and patent applications—the precursors of an awarded patent—are not guarantees of success in the tenure process, promotion, or recognition among peers in academia or in any organization.

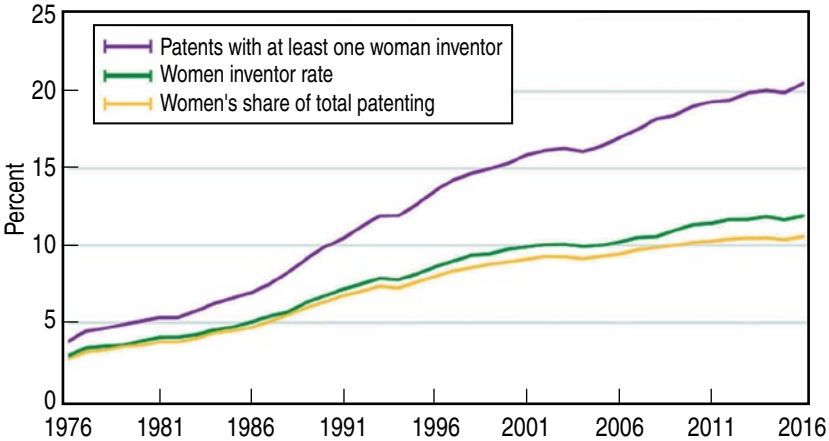

Table I. Forty-Year Trends in Women Patenting[1]

REACH for Commercialization™

REACH for Commercialization™ is a year-round, cohort-based program designed to address the persistent gender gap in technology transfer, patenting, and entrepreneurial activities. REACH consists of a series of interactive workshops, formal and informal networking opportunities, and individual mentoring. The program is designed to amplify the impact of ResEArCH, fast-track academic discovery for the benefit of society, and enhance professional development.

Initially known as "Project REACH," the program emerged as the signature initiative of a National Science Foundation ADVANCE Institutional Transformation grant awarded to The Ohio State University (OSU) in 2008. The five-year grant marked the design and launch of a formal program to address the gender chasm in technology transfer at OSU. The year 2020 marks the sixth cohort to participate in REACH. Since its inception, the program has

"Participants are not required to have a commercial idea in mind—only the desire to learn and explore commercialization as another pathway to disseminate their research."
—Mary C. Juhas and Caroline E. Crisafulli

expanded beyond faculty to include research staff, postdoctoral scholars, and select graduate students for a total of 110 women who have participated in the program. Altogether, they are associated with 317 invention disclosures, 307 patent applications, 96 issued patents, and nine startups. Participation is open to women in all colleges and departments and all stages of technology transfer. Participants are not required to have a commercial idea in mind—only the desire to learn and explore commercialization as another pathway to disseminate their research.

While entrepreneurial "boot camp" programs are a valued component of building entrepreneurial capacity, REACH provides additional avenues for women to excel in commercialization and innovation. The program is designed as a complement to the more lock-step boot camps by meeting women where they are in their professional career and in the commercialization process. The result is a highly personalized experience that addresses the spectrum of academic innovation.

Networks are at the core of the program. REACH proactively expands the participants' commercialization ecosystem and animates innovation and collaboration. Prior participants are invited back to engage in all events, and they serve as authentic and approachable role models and near peers. The REACH program has steadily evolved into a flexible, supportive, and continuous resource. On-ramps and off-ramps are built into the program to mitigate barriers and maximize participation. The REACH program works because:

1. REACH is a customized experience. Through individual consultations with the director of innovation and an extensive network of committed mentors, entrepreneurs, and resources, REACH provides personalized pathways for technology transfer. REACH recognizes that stories of failure are as valuable as success stories. It is important for participants to understand the challenges faced in the commercialization process and how to access tools to persevere through those challenges.
2. REACH openly addresses women's lack of self-promotion. REACH encourages self-awareness skills, so participants become comfortable in articulating the need to access money, power, and influence in order to move forward.

REACH Core Workshops

Four Core Workshops cover a broad overview of the technology transfer and commercialization process, as outlined here.

Visioning Impact from Research

Startup founders share their journeys of balancing the demands of an academic career, tenure, promotion, research, technology transfer, and launching a company.

Learning the Landscape

Academic leaders underscore the value of entrepreneurial activity as an important complement that aligns well with and strengthens the traditional linear academic trajectory. Technology Commercialization team members engage with REACH participants individually to describe the commercialization process, initiate relationships, and plan next steps.

Building a Team

Experienced academic innovators emphasize the importance of building a strong team, with diverse skill sets that complement the innovator's expertise. The big takeaway is the innovator isn't responsible for all sides of technology transfer; her primary role is technical expert.

Understanding the Funding Life Cycle

Representatives from a variety of funding sources describe the process and the appropriate time to engage with specific funding mechanisms.

REACH Constellation Workshops

Constellation workshops explore the core workshop themes in greater detail. The topics featured in the constellation workshops are designed expressly by the needs and interests of the participants. Examples of constellation workshops include:

- Increasing Research Visibility
- Creating a Professional Brand
- Optimizing Professional Conferences
- Introduction to Intellectual Property Licensing
- Introduction to New Venture Creation
- Customer Discovery
- Copyrights and Trademarks
- Patents and Patent Searches

Lessons Learned

1. Personal invitation to participate is the most effective way to recruit.
2. Despite the fact that participants are highly accomplished in their field, they feel embarrassed about an unfamiliarity with the technology transfer process.
3. Schedule events during work hours to maximize participation.
4. Female role models and mentors are most effective.
5. The program became markedly richer and more productive when women from all academic disciplines were invited.
6. New interdisciplinary collaborations routinely initiate within and among REACH cohorts.
7. Follow each workshop with short flash surveys to enhance personalized programming. Make adjustments in real time based on the needs and feedback of the cohort.
8. Survey tools developed under Institutional Review Board protocol informed the core workshop topics. Pre- and post-program surveys (19 questions) have been refined over the years.
9. The COVID-19 pandemic has created an opportunity to reimagine programming and improve the REACH network. All workshops are currently held virtually and recorded, increasing flexibility and accessibility.

Next Steps

We are seeking partners for a pilot to translate the REACH program to other academic institutions, corporations, and national laboratories. These new partnerships will expand the community of women innovators, initiate collaborations, and introduce new role models and mentors. Additionally, we hope to continue to expand beyond the STEM and health sciences disciplines to include more participants from social and behavioral sciences, arts, and humanities, as well as the participation of postdoctoral scholars.

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STEMulating a New K–12 Pathway

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In order to meet our current challenges, our workforces need to closely represent our demographics. The globalization of the world is creating an environment that requires diversity of skills and thoughts. In fact, the literature would suggest that organizations that have sought to hire a diverse workforce are succeeding at a more rapid pace due to their ability to innovate. In particular, organizations that require STEM-related experiences are especially in need of the intentional recruitment of a workforce that resembles the demographics of the environment. One way to meet this need would be to engage more underrepresented minorities (URMs) and women in STEM pathways at an earlier age. For the purposes of this article, URM is defined as Black and Latinx.

Historically, the involvement of underrepresented minorities and women in STEM pathways has been limited. While there has been overall growth in college enrollment throughout the past decades, the number of underrepresented minority graduates for STEM fields has remained relatively stagnant as many college students lack the interest or the qualifications to gain admission into and/or compete in STEM programs. Currently, much of the investment and energy from government efforts has been focused on supporting initiatives and training to improve student perceptions of STEM. Specifically, these programs have aimed to encourage more URM youth and girls to enter and follow STEM pathways. However, given the state of public education, what strategies are effective in increasing the students' interest in STEM fields when they have not previously been exposed to them or have even considered them an option?

> *"Furthermore, some parents may feel uncomfortable with STEM topics and, as a result, are not able to encourage their children to pursue STEM degrees."*
> —Whitney Gaskins et al.

Several reasons exist for the gap in interest in STEM education by URMs and women. Most evident is the lack of visibility in their environment. There is a notable deficiency in the visibility of these groups in STEM fields. Currently, images of women and minorities are abundant in business, entertainment, and athletics. Consequently, these are the areas where they show the most interest. Furthermore, some parents may feel uncomfortable with STEM topics and, as a result, are not able to encourage their children to pursue STEM degrees. Finally, many schools in urban communities are under-resourced and are unable to adequately prepare K–12 students to enter STEM post-secondary education. The data would show that a majority of urban public-school systems receive failing grades, especially in math and science. As a result, students become disinterested in pursuing STEM fields, as they equate the failure to disliking,

> *"While there has been overall growth in college enrollment throughout the past decades, the number of underrepresented minority graduates for STEM fields has remained relatively stagnant…"*
> —Whitney Gaskins et al.

which further ingrains the sense of unpreparedness.

Since its inception in 2013, the Gaskins Foundation (TGF) has worked to create new evidence-based pathways for hundreds of underrepresented minority and women students to enter STEM pathways. The organization has partnered with Cincinnati Public Schools to serve as the Community Lead Agency for three STEM-focused elementary schools, serving 1,200 K–6 students, and the local STEM-focused high school, representing nearly 1,000 7–12 grade students.

The Gaskins Foundation's purpose is to develop solutions to increase the number of students who are prepared to enter into and matriculate through collegiate STEM programs. The Foundation's signature program, STEMulates, is supported by a framework called the P.E.P. (Present, Engage, Prepare) model. The P.E.P. model positions our students to perform at least one grade level above current educational standards and is detailed in the following.

P.E.P.

- *K–3rd: Present:* The K–3rd grade program introduces our youth to STEM. They are introduced to pre-algebra, programming, and hands-on design projects.
- *4th–6th: Engage:* The 4th–6th grade program teaches STEM concepts by having the students complete engineering and scientific design challenges.
- *7th–12th: Prepare:* The 7th–12th grade program ensures that students have the foundation to succeed in college from the time they begin their freshman year of college up until they begin their academic, corporate, or government careers.

The Foundation relies on formal and informal STEM education strategies to increase student STEM interest and aptitude. However, our primary focus is on after school and weekend programming. Additionally, we provide educational programming to support families outside of the classroom. Our major initiatives are Numeracy, STEMulation Zones, and STEM Ready.

Numeracy

The numeracy initiative is focused on creating awareness around the importance of understanding mathematics. Our goal is to make numeracy, often referred to as mathematical literacy, as relevant and important in our community as literacy. It is believed that 90% of all new jobs will require some background in STEM, which is built upon having a strong foundation in mathematics. We have three critical checkpoints for student assessment at the 4th, 8th, and 11th grades, which are aligned with current standardized testing.

Algebra by 7th Grade (AB7G) is a cohort model program that supports students in grades K–7. The goal of this program facilitates the ability of students to become proficient in algebra by the end of the 7th grade. This supports the accepted belief that mastering algebra by the 8th grade is a gateway skill to succeeding in a college engineering program.

Furthermore, students in the program are provided with access the Assessment and LEarning in Knowledge Spaces (ALEKS) web-based mathematics literacy program. The program coordinators monitor student progress and provide additional lessons. On two Saturdays per month, students have an in-person session. During the Saturday sessions, the first hour is spent working on ALEKS and the second hour is spent tutoring or performing hands on activities related to the subject matter. To ensure continuity in programming, each family is expected to log on for an hour each week at home to complete an ALEKS assignment. This intervention is supported by the evidence that demonstrates a positive correlation between the amount of time spent outside of the classroom and performance within the classroom.

STEMulation Zones

STEMulation Zones are neighborhood spaces in which students can learn skills and receive support in a safe and nurturing environment that will allow them to learn freely and effectively contribute to the growth of their communities. Research shows that weekends, after school, and summer break are the most

"The Foundation relies on formal and informal STEM education strategies to increase student STEM interest and aptitude."
—Whitney Gaskins et al.

dangerous times for urban youth. These STEMulation Zones provide a safe outlet for the youth in our communities. STEMulaton Zones are strategically placed in churches, recreation and community centers. The spaces are free and open to the community. Local volunteers from universities and companies serve as tutors and workshop facilitators for students who participate in the programming. Curricula for the STEMulation Zones are created by collegiate and K–12 educators as well as STEM industry professionals.

Programming

STEMulating Saturdays is a monthly program designed to increase student participation in STEM activities through hands-on challenge-based learning experiences. The students are separated into three groups: K–3, 4–6, and 7–12. The K–3 group focuses on introducing concepts. The 4–6 group focuses on using activities to help understand concepts that they are learning in class. The 7–12 group focuses on creating their own projects and designs using STEM concepts and principles.

STEMTime is a virtual educational experience that curates STEM projects and experiences in which families can participate at home. Each week, students complete one hour each of math, programming, and hands-on stem projects delivered via online platforms with the support of their family. Volunteers are available to support families as needed. Our STEMTime Clubs provide opportunities for students to compete in local, regional, and national engineering competitions.

STEM Ready

The goal for students entering our STEM pathway is to develop students who are "STEM Ready." STEM Ready means that students are ready to succeed in a first-year collegiate STEM program. By the end of the 6th grade, we want the students in our pathway to be able to complete introductory algebra, programming, and design projects. Our goal is for students finishing 12th grade to have completed calculus, physics, and chemistry courses, score at least a 24 on the ACT, and have mastered an engineering or scientific-design capstone project, as well as two programming languages.

"…our engagement with parents has facilitated persistence in the program by students and has encouraged better results in school."

—Whitney Gaskins et al.

Lessons Learned

An essential lesson that we have learned is the importance of programming being inclusive of parents. Specifically, our engagement with parents has facilitated persistence in the program by students and has encouraged better results in school. Another critical lesson is the importance of diversity in programming. Having volunteers who are college-aged or professionals, who may also be URMs, has an impact on students and their families. This intentional selection of volunteers has led to many mentor-protégé relationships being developed within our programs. Finally, our leadership has learned that the relationship with families is as important as the relationships with schools, churches, and community centers. These relationships are the cornerstone of our programs.

Next Steps

Our primary next step is to expand our program. Our research team is using the data from programming to enhance our current program and create new interventions to support more families. We are also creating new partnerships to expand our program to new cities. We anticipate offering STEMulates in 10 cities nationwide over the next five years, with every metropolitan area in Ohio hosting a STEMulates program within the next 18 months.

Whitney Gaskins serves as assistant dean of inclusive excellence and community engagement at the UC College of Engineering and Applied Science.

Delano White is executive director of Cincinnati STEMulates.

Karen Bankston is a consultant in the area of leadership, equity, and inclusion.

Ashley Paz y Puente is a professor of mechanical and materials engineering at UC and, as a TMS member, is actively involved in the Diversity, Equity, and Inclusion Committee.

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JOM themagazine

TMS meeting headlines

Meeting dates and locations are current as of July 22.
For the most up-to-date list of TMS-sponsored events, visit www.tms.org/Meetings.

Other Meetings of Note

TMS Learning Pathways: Advanced Materials Manufacturing
November 9–11, 2020
Pittsburgh, Pennsylvania, USA

The 11th International Conference on Molten Slags, Fluxes and Salts (MOLTEN 2021)
February 21–25, 2021
Seoul, South Korea

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

Solidification Course 2021
May 30–June 4, 2021
Villars-sur-Ollon, Switzerland

The 12th International Conference on Magnesium Alloys and their Applications (Mg 2021)
June 15–18, 2021
Montreal, Canada

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

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

Additive Manufacturing Benchmarks (AM-Bench 2022)
August 15–18, 2022
Bethesda, Maryland, USA

TMS2021
150th Annual Meeting & Exhibition

March 14–18, 2021
Orlando World Center Marriott
Orlando, Florida, USA
Registration Opens Soon!
www.tms.org/TMS2021

- TMS will celebrate 150 years of bringing together engineers, scientists, business leaders, and other professionals in the minerals, metals, and materials fields for a comprehensive, cross-disciplinary exchange of technical knowledge at the TMS 2021 Annual Meeting & Exhibition (TMS2021).
- Learn how you can get the most out of TMS2021 with the Insider's Guide to the Annual Meeting video series, available in the Attendee Toolbox section of the conference website.
- Book housing at the Orlando World Center Marriott for a stay at the convenient, self-contained resort where all TMS2021 technical programming, exhibit, committee meetings, and social functions will be held.

3DMS

June 29–July 2, 2021
Hyatt Regency Washington on Capitol Hill
Washington, D.C., USA
Abstract Submission Deadline: October 30, 2020
www.tms.org/3DMS2021

- Originally set for 2020, the 5th International Congress on 3D Materials Science (3DMS 2021) is now planned for 2021 and has reopened a call for abstracts. Technical topics include: methods for materials simulation and modeling; materials dynamics in 3D; machine learning; processing-microstructure-property relationships in 3D; and more. Share your work today!

LMPC 2021 Liquid Metal Processing & Casting Conference

September 19–22, 2021
Philadelphia, Pennsylvania, USA
Abstract Submission Deadline: January 8, 2021
www.tms.org/LMPC2021

- Submit an abstract to the Liquid Metal Processing & Casting Conference 2021 (LMPC 2021), which presents a blend of academic and industrial papers on topics including advances in controls and process simulation, ingot defect formation and characterization studies, and process parameter-material properties characterization.
- Exhibitor and sponsorship opportunities are available! Expand your visibility among decision-makers in the field. Visit the conference website to learn more.

MiNES
MATERIALS IN NUCLEAR ENERGY SYSTEMS

September 19–23, 2021
Omni William Penn Hotel
Pittsburgh, Pennsylvania, USA
Abstract Submission Deadline: April 2, 2021
www.tms.org/MiNES2021

- The Materials in Nuclear Energy Systems (MiNES) congress first met in 2019 to serve the fission reactor materials community that grew out of biannual symposia at the TMS annual meeting and the American Nuclear Society (ANS) annual meeting.
- Technical topics for MiNES 2021 will include, but are not limited to: irradiation damage; mechanical properties of irradiated materials; advanced alloys for nuclear materials systems; nuclear fuel cells; and more.

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call for papers

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

March 2021
Manuscript Deadline: October 1, 2020

Topic: Additive Manufacturing: Searching for In-situ Signatures

Scope: While additive manufacturing processes are being optimized through modeling and experimentation, there remains a presence of stochastic anomalies which can adversely affect the quality of parts produced. If such anomalies go undetected, an unfit part may be mistakenly certified for use. Such instances reduce confidence in the use of additive manufacturing in structurally demanding applications. Manuscripts are solicited that seek to identify and characterize anomalous process behavior through analysis of in-situ monitoring data.
Editors: Tom Stockman and Somayeh Pasebani
Sponsor: Additive Manufacturing Committee

Topic: Leveraging Materials in Topology Optimization (By Invitation Only)

Scope: Topology optimization is pushing the frontiers of material design by decoupling and independently optimizing material properties and functionality. Topology optimization offers a mathematical framework to determine the most efficient material layout for prescribed constraints and loading conditions. It offers a framework for accessing unexplored and previously unachievable areas of material-property space. This topic will feature several invited contributions from researchers and artists innovating methods and applications of design and topology optimization for materials.
Editor: Natasha Vermaak
Sponsor: Invited

Topic: Powder Materials for Energy

Scope: This topic will cover powder materials related to energy. It includes powder synthesis, forming (including additive manufacturing), sintering, and property evaluation. The topic intends to cover advances in theory, modeling, and computation while in parallel developing cutting-edge experimental techniques and approaches to understand and characterize powder materials in energy areas. Both theory and modeling and experimental efforts in powder materials synthesis, processing, characterization, and performance evaluation will be covered.
Editors: Kathy Lu and David Yan
Sponsor: Powder Materials Committee

April 2021
Manuscript Deadline: November 1, 2020

Topic: Advances in Process Metallurgy

Scope: Over the past several decades, extensive research and developmental activities have led to the emergence of new methods, processes, and engineering flowsheets in hydro(bio)-, pyro- and electrometallurgy. Incorporation of new modifications into conventional techniques has shown promise in many metallurgical practices. Authors are requested to contribute manuscripts in the areas of materials electrochemistry, chemical metallurgy of secondary resources and strategic (waste) materials, recovery of critical elements, and separation science and technology.
Editors: Hong (Marco) Peng and Kerstin Forsberg
Sponsor: Hydrometallurgy and Electrometallurgy Committee

Topic: Aluminum and Magnesium Alloys for Automotive Applications

Scope: This topic covers the development of aluminum and magnesium alloys specifically for application in the automotive industry. This may include new alloys designed for engines, enclosures, and structural components of vehicles. Also covered is adaptation of existing alloys to the use in automotive applications and specialized joining techniques for these alloys. Papers should contain essentially new scientific and practical data underpinned by advanced characterization and testing, and in-depth analysis of the mechanisms. All submissions should be relevant to automotive applications.
Editor: Dmitry Eskin
Sponsor: Aluminum Committee

Topic: Developments in the Production of Magnesium Alloy Flat Products

Scope: Magnesium alloys are considered to be potential candidates for light-weighting in the transportation sector for improved performance and fuel economy. One of the "holy grail" applications has been automotive body panels, requiring scalable, low-cost, formable sheet production. Substantial research has been conducted in recent decades and this special topic invites submission of reviews on the advances made as well as of emerging research avenues e.g. friction stir processing, dynamic cutting extrusion, and twin-roll casting.
Editors: Jishnu J. Bhattacharyya and Aeriel Murphy-Leonard
Sponsor: Magnesium Committee

Topic: Materials Recovery Considerations for Design of Next-generation Functional Materials

Scope: There is an urgent need to find smart practices to enhance the sustainability of energy conversion, storage, and manufacturing practices such as additive manufacturing and green manufacturing by incorporating novel design. This special topic invites industry leaders, as well as scientists, academics, and students to publish their best practices in industry, and frontier research in sustainability.
Editors: Surojit Gupta, Lan (Samantha) Li, and Manoj Kumar Mahapatra
Sponsor: Energy Conversion and Storage Committee

May 2021
Manuscript Deadline: December 1, 2020

Topic: 8th European Conference on Renewable Energy Systems (By Invitation Only)

Scope: This special topic will publish invited papers presented at the 8th European Conference on Renewable Energy Systems. The areas of coverage will include energy materials, optoelectronic materials, semiconducting, compounds, alloys, and composites of potential use in energy applications. In addition, submissions related to synthesis and characterization of materials for energy conversion, solar energy, wind energy, fuel cells, and energy storage materials are included.
Editors: Shadia Ikhmayies and Hilal Kurt
Sponsor: Invited

Topic: Adaptive Metallurgical Processing Technologies for Strategic Metal Recycling

Scope: The demand for strategic metals has enabled many new technologies for recycling of complex materials. In the meantime, traditional metallurgical processes also need to be adapted to address techno-economic barriers. This special topic is open to researchers from both industry and academia in areas of strategic metal recycling. Papers providing perspective on technical challenges or broader materials science challenges toward sustainability are also welcome.
Editor: Mingming Zhang
Sponsor: Recycling and Environmental Technologies Committee

Topic: Microstructure Characterization: Descriptors, Data-Intensive Techniques, and Uncertainty Quantification (By Invitation Only)

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

Topic: Thermodynamic Considerations for Improved Renewable Energy Production

Scope: Municipal and industrial wastes are increasingly becoming important sources of renewable energy. However, fouling, slagging, and corrosion associated with the combustion processes of these resources are costly, and threaten the long-term operation of power plants. Papers focusing on the thermodynamic modeling of problematic sulfates and chlorides in the waste combustion processes are welcome. Research papers on emission control pertaining to the renewable energy industries are considered. Manuscripts intended for a broad readership are especially encouraged.
Editors: Fiseha Tesfaye
Sponsors: Process Technology and Modeling Committee and Recycling and Environmental Technologies Committee

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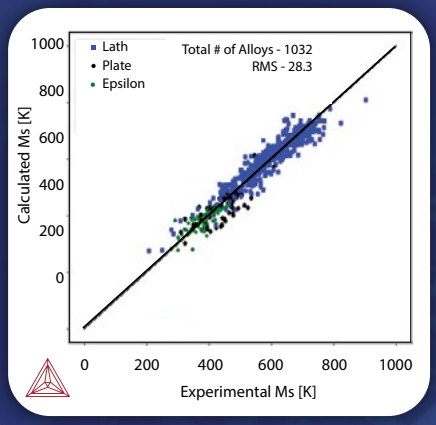
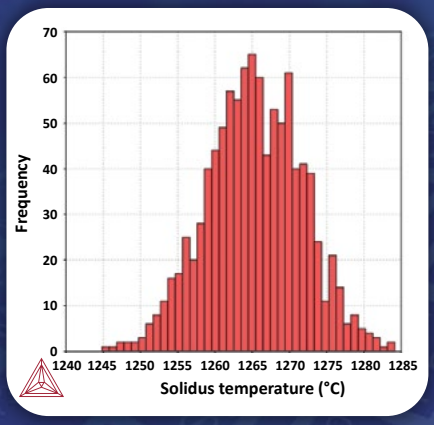


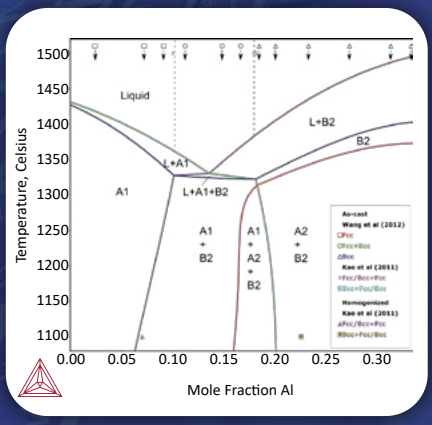
Comparison of calculated and experimental Ms temperatures for a wide range of steels

Nickel



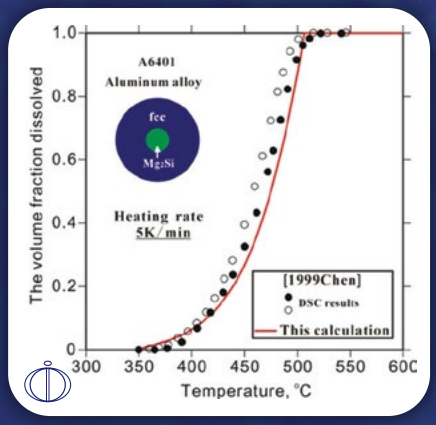
Variation in solidus temperature over 1000 compositions within alloy 718 specification

High Entropy Alloys



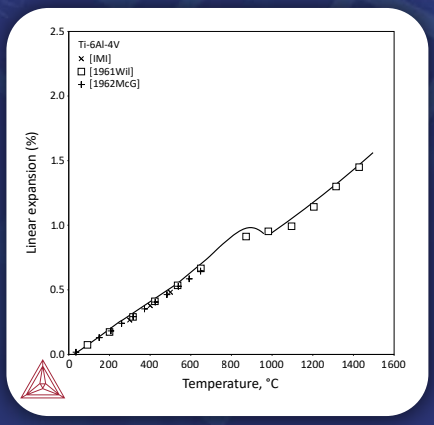
Calculated phase diagram along the composition line of CoCrFeNi-Al

Al Alloys



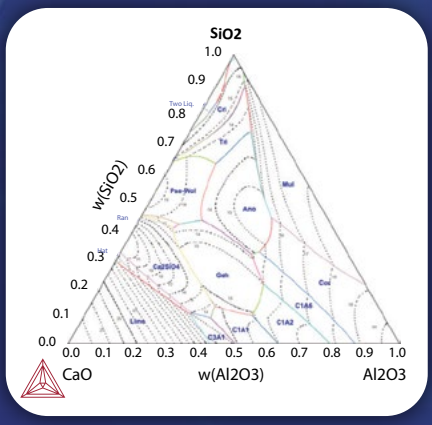
Dissolution of Mg2Si precipitate in Alloy A6401

Ti and TiAl Alloys



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

Oxides



Ternary liquidus projection in oxide systems

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