JULY 2022
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News and insights about TMS, its members, and the professions it serves

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Spotlight on Artificial Intelligence: AIM 2022 Review

TMS Springer

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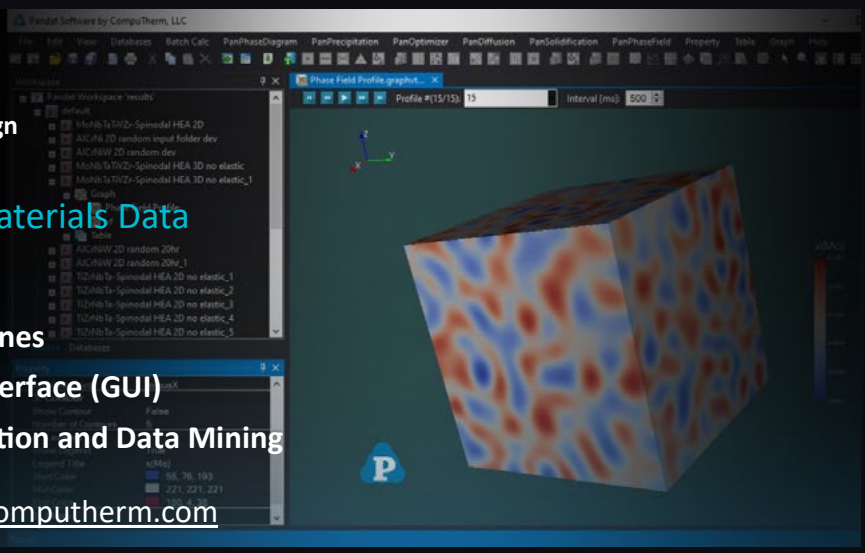

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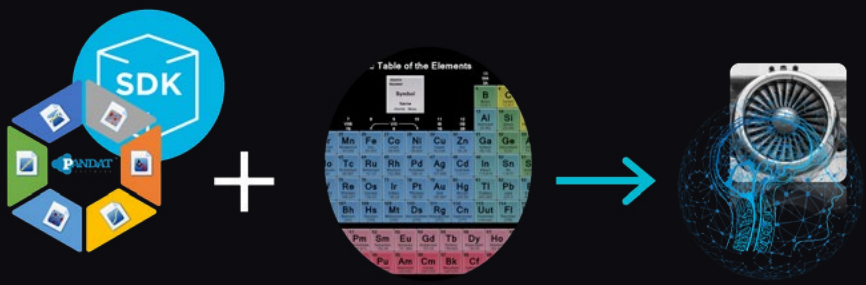

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- chemical driving force

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- particle size and size distribution
- multi-phase co-precipitation

PanDiffusion

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

PanSolidification

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

PanPhaseField

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

JOM THE MAGAZINE
News and insights about TMS, its members, and the professions it serves

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TMS
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ABOUT THE COVER

This issue of *JOM: The Magazine* features in-depth coverage of the 2022 TMS Bladesmithing Competition held during the TMS 2022 Annual Meeting & Exhibition, with the winning blade showcased on the July cover. Created by a student team from Missouri University of Science and Technology, the cover image shows close-up details of their historically based blade, "Dämmerung Jagd," notably the intricate design work on the guard and pommel as well as the pattern-welded steel of the blade itself. Pictured in the inset photo is David Blondheim giving the plenary talk at the inaugural TMS World Congress on Artificial Intelligence in Materials and Manufacturing (AIM 2022). Read the congress review in "TMS Member News" this month.

Access Technical Journal Articles

TMS members receive free electronic access to the full library of TMS journals, including *JOM*. Technical articles published in *JOM*: The Journal are available on the Springer website. TMS members should log in at www.tms.org/Journals to ensure free access.

About *JOM: The Magazine*:

This print publication is excerpted from the publication of record, *JOM*, which includes both The Magazine and The Journal sections. *JOM: The Magazine* includes news and insights about TMS, its members, and the professions it serves. To access the publication of record, visit www.tms.org/JOM.

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. Learn more at www.tms.org.

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IN THE FINAL ANALYSIS

JOM THE MAGAZINE

> *"We constantly see surveys that reveal this ignorance, especially among our high school students, 78 percent of whom, in a recent nationwide multiple-choice test, identified Abraham Lincoln as 'a kind of lobster.' That's right: more than three-quarters of our nation's youth could not correctly identify the man who invented the telephone."*
>
> —Dave Barry

Volume 74
Number 7
July 2022

Newspaper columnist Dave Barry is one of my favorite humorists. If you are not familiar with his work, Barry's modus operandi is to take a generally factual observation and then conflate it with amusingly fallacious extrapolations. Take the quote above as a classic example. It gives a solid chuckle, but it also suggests two practical business tenets: First, a survey analyst never knows what they will find when considering survey results; second, the survey analyst has to be careful to avoid corrupting the analysis with their own biases or defective knowledge.

I like to remind myself of these lessons whenever I review survey results. We'll see how good I am in practice as I spend the remainder of this column offering my initial observations from the latest TMS membership survey. We conduct a survey of the professional membership every two years. The goal is to better understand members' perspectives on the Society and learn if we can serve them better. A caveat: I am commenting only on some results that made me say, "Hmmm, that's interesting." A deeper dive will be conducted in the coming weeks. So, what intrigued me?

1. We had a 12% response rate, which tracks with 2020's survey participation. Generically, a minimum desirable response rate is 5% as long as the response pool is representative. Participants were 36% from academia, 34% from industry, 15% from government, and the remainder were largely retired—that's reasonably tightly aligned with the TMS membership demographic.
2. 55% of survey respondents can be classified as "promoters" of the Society (i.e., people who, on a scale of 1-10, selected "9" or "10" in their willingness to recommend TMS to others). This is up from 46% in 2020.
3. Less than 25% of respondents have their annual dues paid for by their employers.
4. The top benefit of membership in TMS? 75% assign "high value" to having digital access to the TMS family of journals.
5. The top two reasons for becoming a member of TMS? There's a lot of variety here, but top with 21% is, "To support the profession and TMS's mission." Second, with 19%, is, "To have access to a network of peers."
6. The top reason for remaining a member of TMS? Again, a lot of variety but the prevalent reason for 38% respondents is because, "TMS is the professional society that best serves my interests."
7. In response to the question, "What other professional societies do you hold membership in?" more than 130 separate societies were cited in the responses. That said, 17% of respondents hold a single membership and that is with TMS.
8. While respondents are engaged with other professional societies, 62% say that they consider TMS to be their "primary professional society home."
9. The two most common barriers to "becoming actively involved with the TMS community"? Being "unable to attend in-person events" (22%) and "current work demands do not allow me to engage" (18%). 43% of respondents report that they have no barriers to their participation.
10. Common pain points of respondents? I'll summarize the prevalent write-in answers as access to funding and difficulties in the workplace. We'll give analysis of this section considerable attention.

My primary and most gratifying takeaway from the survey? No respondent referred to TMS as being a "kind of lobster."

James J. Robinson
Executive Director
@JJRofTMS

"We conduct a survey of the professional membership every two years. The goal is to better understand members' perspectives on the Society and learn if we can serve them better."

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JOM TECHNICAL TOPICS

JOM THE MAGAZINE

JOM: The Journal publishes peer-reviewed technical articles covering the full range of minerals, metals, and materials. TMS members receive free electronic access to the full library of TMS journals, including *JOM*. For the full *JOM* Editorial Calendar, visit **www.tms.org/EditorialCalendar**.

Review the technical topics included in the current issue of *JOM*: The Journal here, and then go to **www.tms.org/JOM** to log in and access technical journal articles on the Springer website.

JULY 2022

In-situ Methods for Understanding Deformation & MS Evolution in Mg Alloys

Scope: Magnesium and its alloys have many unique transformations that occur during loading and thermomechanical processing due to its HCP crystal structure. Advanced in-situ characterization techniques are powerful tools for providing valuable information in real time. When used in combination with mechanical loading, processing techniques, and thermal treatments, comprehensive studies have been carried out to understand complex relationships between processing, structure, and properties.
Editors: **Aeriel Leonard**, The Ohio State University, and **Domonkos Tolnai**, H.G. Zimmermann GmbH
Sponsor: Magnesium Committee

Magnetic Materials for Multifunctional Applications

Scope: Papers are presented on magnetic materials which can be used for multifunctional applications in the power and energy sector (energy conversion, energy storage, power generation, etc.). Fundamental and applied research in this area with an emphasis in novel processing, and the interplay between composition-processing-structure-microstructure-property-performance is welcome. Peer-reviewed manuscripts based on original research, literature review, and scientific viewpoint will be considered for publication. This call targeted scientists/researchers from diverse groups such as early career professionals, graduate students, academics, industry, and national labs to submit their research.
Editors: **Surojit Gupta**, University of North Dakota; **Radhika Barua**, Virginia Commonwealth University; **Manoj Mahapatra**, The University of Alabama at Birmingham; and **Lan Li**, Boise State University
Sponsors: Advanced Materials Committee, Magnetic Materials Committee, and Nanotechnology Committee

Contribute to *JOM*: The Journal

Visit **www.tms.org/JOM** to access author tools that will answer your questions during every step of the manuscript preparation process, from determining the appropriate technical topic for your paper to reading the final product on SpringerLink.

For further information on contributing to *JOM*, contact *JOM* Editor Maureen Byko at mbyko@tms.org.

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https://doi.org/10.1007/s11837-022-05353-6

TMS MEMBER NEWS

JOM THE MAGAZINE

Share the Good News!
Contact Kaitlin Calva, *JOM: The Magazine* Principal Editor, at kcalva@tms.org to share your professional accomplishments. Please note that only news submitted by current TMS members will be considered.

Researchers and Manufacturers Gather at AIM 2022

Among the much-anticipated live events of 2022, the first-ever TMS World Congress on Artificial Intelligence in Materials and Manufacturing (AIM 2022) took place from Sunday, April 3, to Wednesday, April 6. The meeting on artificial intelligence (AI) attracted over one hundred in-person registrants to Pittsburgh, Pennsylvania.

Attendees mingled and discussed collaboration opportunities at two networking events: Sunday evening's welcome reception and Monday evening's poster reception. Students represented roughly one-third of participants. Attendees at every level of their careers were pleased to be participating in a live event after the pandemic had limited networking opportunities for so long.

James Warren, National Institute of Standards and Technology, moderated a panel talk and Q&A session with the conference organizers, "Challenges and Opportunities in the Application of AI to Materials R&D," that engaged attendees in discussions on pertinent issues. The panelists included conference chair Taylor Sparks, University of Utah; programming chair Adam Kopper, Mercury Marine; Elizabeth Holm, Carnegie Mellon University; and Benji Maruyama, Air Force Research Laboratory.

Mercury Marine's David Blondheim opened the technical program with his plenary talk, "Industry 4.0: Creating the Foundation for Machine Learning in Production Manufacturing," on Monday morning. Since 2017, Blondheim has been charged with leading Industry 4.0 implementation across Mercury Marine Global Operations. His talk gave a sense of the complexity of Industry 4.0 and demonstrated his perspective on applying machine learning within a production manufacturing environment.

"A lot of AI discussions focus on modelling and application. What my work and research at Mercury has been doing has been taking a step back to see how we actually collect that data in production machining and production manufacturing environments, and then how do we actually apply machine learning in an industrial field," Blondheim said.

Wednesday's programming opened with plenary speaker Tegan Emerson, who is a senior data scientist at Pacific Northwest National Laboratory (PNNL) and holds joint appointments at the University of Texas El Paso and Colorado State University. She presented the work of her team at PNNL in the talk titled, "Generating Realistic Material Microstructures Using

Attendees reconnected and met new contacts during AIM 2022.

David Blondheim, Mercury Marine, a division of Brunswick Corporation, talked about applications of machine learning in a production manufacturing environment.

Conditional GANs for Advanced Manufacturing."

The technical sessions fell into different tracks, such as Machine Learning/Deep Learning in Materials and Manufacturing; AI-Assisted Development of New Materials/Alloys; Computer Vision for Materials and Manufacturing R&D; AI in Specific Manufacturing Processes; Autonomous Materials Research; and Human-AI Collaboration for Materials and Manufacturing Problems.

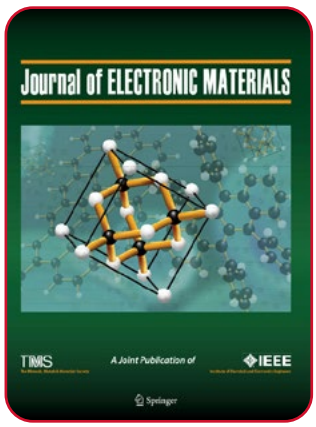
Dozens of registrants also chose to participate in AIM 2022 On Demand, an online platform and meeting app that offered presentations, message boards, and virtual discussion rooms. Thirty-four oral presentations were available to be watched on video, including, "Data-Driven Learning of Constitutive Laws and Material Parameter: from Molecular Dynamics to Continuum Models," by Marta D'Elia, Sandia National Laboratories; "Machine Learning from Large and Sparse Data for Novel Materials Discovery," by Fadwa El-Mellouhi, Hamad Bin Khalifa University; and "Methods of Surface Inspection for Plane Metal with the Use of CV," by Maxim Shamshin, United Metallurgical Company.

For TMS meetings that offer an on-demand option, the virtual platform is available for up to two months after the event. It has been one way that TMS has engaged with individuals whose travel has been limited during the pandemic. At AIM 2022, it was clear that attendees who were able to travel appreciated the opportunity to reconnect, learn, and prepare for a future of AI in research and manufacturing.

Download the New AI Study

Attendees of AIM 2022 had a chance to pick up a printed copy of the latest TMS science and technology accelerator study, *Employing Artificial Intelligence to Accelerate Development and Implementation of Materials and Manufacturing Innovations*. The report comes from a TMS-led team of eleven internationally renowned experts, with funding support provided by the National Institute of Standards and Technology (NIST) and the Office of Naval Research (ONR). Download your free digital copy by going to **www.tms.org/AIstudy**.

Journal of Electronic Materials Seeks Submissions for Topical Collection



The *Journal of Electronic Materials* is planning a new topical collection, **Advanced Metal Ion Batteries**. This collection will highlight recent progress on advanced materials for metal ion batteries and present a broad overview on new synthetic methods as well as novel electrochemical techniques revealing reaction mechanisms. Article submissions are due by **August 31, 2022**.

Topics will include, but are not limited to:

- Electrode materials for metal ion batteries
- Assembly design of metal ion batteries
- Electrochemical techniques for metal ion batteries
- Electrolyte for metal ion batteries
- Separator for metal ion batteries
- Modeling, simulation, and computation of electrode materials

To submit your work, go to www.editorialmanager.com/jems and select article type "2022 Metal Ion Batteries." Author instructions and additional journal details are available at www.springer.com/11664.

The guest editors for this topical collection are Xinhui Xia, Zhejiang University, and Yongqi Zhang, University of Electronic Science and Technology of China.

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Did you know that TMS members have the opportunity to publish their work in books through a partnership between the Society and Springer? As one of the largest and most respected scientific publishers, the Springer platform offers a global audience for your work. To learn more or for questions about publishing your work in the TMS-Springer book series, contact publications@tms.org.

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Read on to explore recently released titles, now available.

Metallurgy in Space: Recent Results from ISS

This book presents experimental work conducted on the International Space Station (ISS) in order to characterize metals and alloys in the liquid state. The internationally recognized contributors present and discuss experiments performed in microgravity that enabled the study of the relevant volume and surface related properties free of the restrictions of a gravity-based environment. The collection also serves as a handbook of space experiments using electromagnetic levitation techniques.

Hydrometallurgy: Fundamentals and Applications, Second Edition

This revised, new edition retains its class-tested coverage of how metals behave in water while updating and expanding information about metals processing methods. The book further retains its emphasis on predicting and engineering the way metals are extracted from ore sources, separated from unwanted entities, recovered as metals, and purified using water-based processing. The transformation of minerals to metals requires hydrometallurgical processing for nearly all of the nonferrous metals we use. This book elucidates the associated fundamentals and processing applications as well as related tools to assess processes and performance.

Physical Chemistry of Metallurgical Processes, Second Edition

This updated, second edition retains its classroom-tested treatment of physical chemistry of metallurgical topics and adds new data in worked-out examples as well as up-to-date references to the literature. The book further explains the physical chemistry of various metallurgical topics, the steps involved in extraction of metals.

Inert Anodes for Aluminum Electrolysis

This book examines recent developments in inert anodes for aluminum electrolysis. It describes the composition and application of the most promising metal ceramic inert anode materials and nickel-oxide nanotechnology in the aluminum industry. The volume addresses concepts, analysis, properties, conductivity and corrosion, microstructure and microanalysis, and machinability of inert anodes for aluminum electrolysis.

Electronic Waste and Printed Circuit Board Recycling Technologies

This book covers state-of-the-art technologies, principles, methods, and industrial applications of electronic waste (e-waste) and waste PCB (WPCB) recycling. It focuses on cutting-edge mechanical separation processes and pyro- and hydrometallurgical treatment methods. The volume discusses the available industrial equipment and plant flowsheets used for WPCB recycling in detail, while addressing potential future directions of the field.

Fundamentals of Strength: Principles, Experiments, and Applications of an Internal State Variable Constitutive Formulation, Second Edition

Coming soon, this second edition updates and expands on the first edition, augmenting discussion of dynamic strain aging and austenitic stainless steels and adding a section on analysis of nickel-base superalloys that shows how the mechanical threshold stress (MTS) model can be used to de-convolute synergistic effects. The new edition retains a clear and rigorous presentation of the theory, mechanistic basis, and application of the MTS model.

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FORGED WITH FORTITUDE:

THE 2022 TMS BLADESMITHING COMPETITION

Megan Enright

"The entries keep getting more impressive with each competition."

—Garry W. Warren, introducing the 2022 TMS Bladesmithing Competition teams

"Completing an entry is no small feat, even on the best of terms...This year's competition stands out in particular since your teams have had to overcome challenges and disruptions of a global pandemic in addition to making your blade," said Garry W. Warren, chair of the TMS Foundation Board of Trustees, as he commended the 2022 TMS Bladesmithing Competition teams in opening the 2022 TMS Bladesmithing Competition Awards Ceremony. Held during the TMS 2022 Annual Meeting & Exhibition (TMS2022), 18 teams of university students rose to the challenge of forming a blade through hand hammering or trip hammer forging in the fourth iteration of the TMS Bladesmithing Competition in Anaheim, California.

On display in the Exhibit Hall, TMS2022 attendees were delighted with this year's entries. Postponed from TMS2021 Virtual due to the COVID-19 pandemic, this unique program provides the next generation of scientists and engineers with an opportunity "to demonstrate their creativity, resourcefulness, artistic talents, and determination as well as their knowledge of materials. The entries keep getting more impressive with each competition," Warren continued. Physical skill, academic rigor, and artistic craftsmanship are married through this competition as each entry is judged on a cumulative score for their blade, report, poster, and video submission.

Continue reading this article for a presentation of this year's award and special citation recipients, as well as all of the 2022 competitors. Learn more about how each team forged their blade and what it takes to complete an entry by viewing the team videos at **www.YouTube.com/ChannelTMS/Playlists** under the TMS Bladesmithing Competition 2022 playlist. New details for the next TMS Bladesmithing Competition, to be held at TMS2024 in Orlando, Florida, will be posted soon. Check **www.tms.org/Bladesmithing** for news and updates.

TMS WADSWORTH-SHERBY GRAND PRIZE

The TMS Wadsworth-Sherby Grand Prize is made possible by the generous support of Jeffery Wadsworth, retired CEO and president of Battelle, in honor of his late mentor, Oleg B. Sherby, Stanford University. Both Wadsworth and Sherby are internationally recognized for unlocking the secrets of Damascus steel and other ancient sword-making processes. The recipient of this award receives a $2,000 cash prize, the TMS Wadsworth-Sherby Bladesmithing Grand Prize Medal, and a commemorative volume of the *Wadsworth-Sherby Collected Works on Damascus Steels & Related Topics*.

"Oleg Sherby would just love to have been here. He would have been so proud of all the work that's been done. He and I did try to make some knives together, but none of them were as beautiful the ones I saw this week here. So, congratulations, the work is just outstanding," Wadsworth said as he presented this award at the 2022 awards ceremony.

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

"Dämmerung Jagd"

Team Members: Jeremiah Cohn, Michael Fitzmaurice, Kyle Hayden, Hans Pommerenke, and Richard Tobey

"Dämmerung Jagd" or "Hunt in the Twilight" is based on a European hunting sword known as the "Hunting Hanger." Hanger swords, originating in 16th century Europe, were an evolution of hunting daggers. The body of this blade is a pattern-welded Turkish Twist Damascus steel, with an additional edge of 52100 high carbon steel. The combination of a pattern-welded body and high-carbon steel edge marries artistic skill and the mechanical benefits of a modern alloy steel. The decorative guard and pommel, as well as the copper inlaid rose wood handle, reflect the historical purpose of hanger swords as a status symbol.

"Oleg Sherby would just love to have been here. He would have been so proud of all the work that's been done."

—Jeffrey Wadsworth, on presenting the TMS Wadsworth-Sherby Grand Prize

FROM OVERCOMING HURDLES TO THE WINNING BLADE

"I was pretty sure there was no chance we were going to win…I wasn't sure that we could stand with the competition and there were some beautiful blades here. I am so honored to be able to claim this prize and stand amongst them," said Jeremiah Cohn, captain of the Missouri University of Science and Technology (Missouri S&T) team after receiving the TMS Wadsworth-Sherby Grand Prize for their blade, "Dämmerung Jagd."

The team from Missouri S&T was no stranger to challenges when putting together their submission for the 2022 TMS Bladesmithing Competition. After drawing up preliminary designs in 2020, the team was not dissuaded after the competition was postponed to TMS2022. They continued to persevere through needed maintenance to their forge, months-long delays for necessary maintenance materials due to limited supplies, an unavailable belt grinder, a three-sixteenths-inch gap when attaching the handle and pommel to the blade, a trip to an Anaheim Auto Zone when a piece of their blade didn't make the trip, and more.

Cohn summarized the team's tenacity and dedication to overcoming these hurdles and winning the competition, "it came together because of the wonderful team we worked with. Winning this is just a dream come true."

Above: Missouri S&T teammates, Jeremiah Cohn (left) and Kyle Hayden (right), pose with their winning entry in the Exhibit Hall at TMS2022.

SECOND PLACE

The recipient of this award receives a $500 cash prize and a certificate.

South Dakota School of Mines and Technology

"Model 1860 Light Cavalry Saber"

Team Members: Connor Heath, Christopher Mercado, Tyler Reinarts, Antonio Romero, Emma Soehl, and Nicholas Stogdill

This blade was a recreation of light cavalry sabers which were first used during the American Civil War. The blade was forged from AISI 1095 high-carbon steel, as it has a similar composition to steels used in the 19th century by sword manufacturers. The blade was hand forged and received treatments inspired by the historical knives of Frank Richtig. The pommel and guard were formed through metal casting and the blade was pattered by electro-etching.

THIRD PLACE

The recipient of this award receives a $250 cash prize and a certificate.

Norwegian University of Science and Technology

"Stuorraniibi – Norwegian Sami Knife"

Team Members: Amalie Farestvedt, Christoffer Fjeld, Trond Hauklien, Jonas Låstad, Brage H. Lysbakken, and Patrick Thomassen

Traditionally used by the Sami people of northern Norway, Sweden, Finland, and Russia, a Sami knife, or Stuorraniibi in the Sami language, is a large, wide-bladed knife primarily used for chopping wood and butchering animals. The design consists of a seven-inch blade with a handle made of both traditional and non-traditional materials, including Japanese ebony wood, "valbjørk" or curly birch, and reindeer horn. As is traditional in northern Europe, the blade is laminated; 80CrV2 was used for the edge steel which is clad in alternating layers of nickel and C75 carbon steel.

HONORABLE MENTION

The recipient of this award receives a $100 cash prize and a certificate.

University of Michigan, Ann Arbor

"Wakizashi"

Team Members: Mitry Anderson, Wahaj Ansari, Harrison Biggs, Alfonso Botta-Lopez, Aidan Charmley, Jesse Hu, Kai Huie, Shriya Jaggi, Megan Klein, Tyler Lindemann, Amy Liu, Jason Manassa, Donovan McPherson, Krystal Quinn, Nick Russell, Grant Saxman, Jeffrey Tschirhart, Yichen Wang, Kevin Wang, and Allen Zhao

This blade is based on the tanto blade which originated in Japan. Typically worn by the samurai class as a weapon, over time these blades became more common with both ornamental and ceremonial significance. This blade is inspired by middle Muromachi period long daggers and features a shinobi zukuri geometry and a simple wood handle and scabbard with a copper fitting.

SPECIAL CITATIONS

Special citations are awarded to acknowledge blades that showed outstanding performance in individual categories such as beauty, creative use of materials, and resourcefulness.

BEAUTY

Texas A&M University

"For Reveille"

Team Members: Sophia Ahmed, Charles Borenstein, Jose Cortes, Michael Deckard, Milos Dujovic, James Gonzales, Denali Ibbotson, Kyle Kaczmarek, Daniel Lewis, Seth Mehalic, Aidan O'Donnell, Nathan Santangelo, Adam Shen, David Stout, Brian Torrini, and Kennon Wishert

Admission to Texas A&M University was originally contingent on becoming a member of The Corp of Cadets, a military leadership training program. Sabers carried by Corp of Cadets members follow the specifications of their intended branch of the U.S. military. In addition, Texas A&M University has its own saber, which is less strict in form and often features etchings or engravings on university themes. This blade features etchings of the Texas A&M University mascot, Reveille, and the university logo. The blade is composed of 8670 steel and low-carbon mild steel was selected for the saber's guard.

BEAUTY

University of California, Berkeley

"Damascus Kukri"

Team Members: Saleem Aldajani, Jason Duckering, Tim Genda, Sebastian Lam, and Chai Peddeti

This blade was based on the Kukri, a machete type weapon originating in India, with slashing and chopping being its primary functions. The "Damascus Kukri's" blade is twisted Damascus comprised of the steel alloys 1080 and 15N20. The blade's pommel was created from a section of railroad track and the guard was forged from an additional section of the blade's Damascus.

CREATIVE USE OF MATERIALS

Arizona State University
"Renaissance Short Sword"
Team Members: Carsen Cartledge, Julia Greteman, Quinlin Meyer, and Brian Ridenour

This blade was based on the Italian Cinquedea, a sword or dagger characterized by its width at the crossguard, creating a distinct triangular silhouette, popular in the 15th century Renaissance period. The team set out to create a blade with all locally sourced materials, including collecting 62 pounds of magnetite sand (Fe_3O_4) from local black sand deposits for the blade. Utilizing the canister pattern-welding method, the team highlighted the low-carbon black sand while mimicking the complex and infamous Damascus pattern in this blade.

RESOURCEFULNESS

Massachusetts Institute of Technology
"The NeverDull Blade"
Team Member: Gianluca Roscioli

This blade was created with a new method to produce sharp edges. This method relies on localized, cumulatively severe plastic deformation using a series of rolling stations with tapered rolls to modify the cross-section of a strip of metal from rectangular to an increasingly more emphatic hourglass shape after each station until it is split into two independent sharp edges after the last station. This blade is composed of commercial low-carbon steel (1075).

HONORING STANLEY M. HOWARD

"I'd like to take a moment to honor one of the founders of the TMS Bladesmithing Competition, Stanley M. Howard. He was passionate about bladesmithing as both an artform and a teaching tool. It was through his vision and determination that TMS was able to establish the successful TMS Bladesmithing Competition that we have today," said Michael West, Bladesmithing Committee Chair, at the 2022 TMS Bladesmithing Competition Awards Ceremony at TMS2022. The 2022 Bladesmithing Competition Awards Ceremony was dedicated to the memory of Stanley M. Howard, who passed away in May 2021. Howard was professor emeritus at South Dakota School of Mines and Technology, a TMS Foundation trustee, the 2016 TMS President, and an incredible friend to TMS.

Stanley M. Howard (left; above, at podium), 2016 TMS President, congratulates the 2017 TMS Bladesmithing Competition participants on their hard work at the 2017 awards ceremony.

CONGRATULATIONS TO ALL OF THE 2022 TMS BLADESMITHING TEAMS

Colorado School of Mines
"The Mines Blade"

Rice University
"Noctua"

Illinois Institute of Technology
"Aluminum Bronze Khopesh"

University of Arizona
"Amaterasu"

McMaster University
"Tanto Blade"

University of Minnesota, Twin Cities
"Filipino Sansibar"

Montana Technological University
"Gladius De Re Metallica"

University of North Texas
"Japanese Bunka Knife"

Purdue University
"Boiler Blade"

The University of Texas at El Paso
"Kukri Knife"

BLADESMITHING SYMPOSIUM AT TMS2023

Held in alternating years with the TMS Bladesmithing Competition, students have the opportunity to present their current work on bladesmithing topics at the TMS Bladesmithing Symposium. Be on the lookout for more information about the TMS Bladesmithing Symposium at the TMS 2023 Annual Meeting and Exhibition (TMS2023) in San Diego, California, on March 19–23, 2023. Learn more and share your work at **www.tms.org/TMS2023**.

JOM: The Magazine, Vol. 74, No. 7, 2022
https://doi.org/10.1007/s11837-022-05355-4

TMS Presents the 2023 Board of Directors Nominees

Kelly Zappas

The individuals highlighted in the following pages have been nominated to fill five open positions on the TMS Board of Directors and two technical division chair positions.

These candidates, if elected by the TMS membership, will be installed at the conclusion of the TMS 2023 Annual Meeting & Exhibition (TMS2023), scheduled for March 19–23, 2023, in San Diego, California.

Additional nominations for these positions may be submitted for Board consideration by any 25 TMS members by August 15, 2022. Nominations for qualified individuals should be sent to James J. Robinson, TMS Executive Director, at robinson@tms.org, and should include the nominee's name, biography, and written consent to serve if elected.

If additional candidates are proposed, a majority vote of TMS members will determine who fills the position. If no new nominations are received, the individuals named in this article will be automatically elected on August 16, 2022.

Many board leaders began as members of a TMS technical committee. If you aspire to Society leadership, find out more about how you can get involved today. Visit the TMS Divisions & Committees web pages at www.tms.org/Committees to choose the technical committee that best matches your interests and then fill out the Technical Committee Interest Form. Committee membership is open exclusively to TMS members.

The nominees for the open positions on the 2023–2026 TMS Board of Directors are:

Vice President

Srinivas Chada

Amazon-Project Kuiper

Srinivas (Srini) Chada is a principal engineer at Amazon-Project Kuiper. Prior to that, he held senior-level managerial, engineering, and research positions in the fields of electronics reliability, failure analysis, materials science, and metallurgy at Stryker, Whirlpool, Medtronic, Jabil, Honeywell Electronic Materials, and Motorola. Previously, Chada was chair of the Electronic Packaging and Interconnection Materials Committee for TMS, and he is presently the editor of the *Journal of Surface Mount Technology* for the Surface Mount Technology Association.

Chada holds a B.E. in metallurgical engineering from the National Institute of Technology Karnataka in Srinivasanagar, India. He obtained his M.S. and Ph.D. in materials science and engineering from Marquette University in Milwaukee, Wisconsin, and completed his MBA at Hough Graduate School of Business at the University of Florida in Gainesville, Florida.

A member of TMS since 1988, Chada served on the TMS Board of Directors for two terms as the chair of the TMS Programming Committee and chair for the TMS Functional Materials Division (FMD). Additionally, he was the chair of the TMS Materials and Society Committee, representative to the TMS Publications Coordinating and Programming Committees for the FMD, and a *JOM* advisor.

Financial Planning Officer

Alexis C. Lewis

National Science Foundation

Alexis Lewis is the deputy division director in the Division of Civil, Mechanical, and Manufacturing Innovation in the U.S. National Science Foundation's Directorate for Engineering. She holds S.B., M.S.E., and Ph.D. degrees in materials science and engineering. In 2003, she joined the Naval Research Laboratory, first as a National Research Council postdoctoral associate and then as a member of the technical staff. In 2014, she joined the National Science Foundation as a program director with a focus on materials engineering, advanced manufacturing, and data, computation, and infrastructure. As the deputy division director since 2020, she leads a diverse group of mechanical, materials, civil, operations, biomechanical, and design engineers.

Lewis has been an active member of TMS for 20 years, serving most recently on the TMS Board of Directors as the director and chair for Membership and Student Development. She has also been a member of the TMS Diversity, Equity, and Inclusion Committee and the TMS Integrated Computational Materials Engineering Committee and is past chair of the TMS Advanced Characterization, Testing, and Simulation Committee. Lewis was the recipient of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) Rossiter W. Raymond Memorial Award in 2012 and the TMS Structural Materials Division Young Leaders Professional Development Award in 2013.

Content Director

Jonathan Madison

National Science Foundation

Jonathan Madison is a program director in the Division of Materials Research within the Directorate for Mathematical and Physical Sciences with responsibility for the Metals and Metallic Nanostructures Portfolio at the U.S. National Science Foundation (NSF). Madison joined NSF in 2021 as a Visiting Scientist, Engineer, Educator. Prior to NSF, he was a principal R&D scientist at Sandia National Laboratories in Albuquerque, New Mexico, in the Material, Physical, and Chemical Sciences Center for over a decade.

Madison received his B.S. from Clark Atlanta University in engineering science with a concentration in mechanical engineering in 2003 and received his M.S. and Ph.D. in materials science and engineering from the University of Michigan in 2007 and 2010, respectively. Before his time at NSF, his research interests focused on the intersection of experimental and computational techniques for the quantitative study of microstructure in three-dimensions.

Within TMS, Madison is currently the vice-chair of the Content Development and Dissemination Committee. He has published in several TMS journals, including *Integrating Materials and Manufacturing Innovation, JOM,* and *Metallurgical and Materials Transactions A,* as well as in the Superalloys conference proceedings.

Beyond publishing activities, Madison is a long-standing TMS volunteer with past and current service to multiple technical and functional committees including Advanced Characterization, Testing, and Simulation; Integrated Computational Materials Engineering; Diversity, Equity, and Inclusion; and Leadership Recruitment, to name a few. He has also been a co-organizer or lead organizer for multiple TMS specialty meetings, including the 3rd World Congress on Integrated Computational Materials Engineering in 2015 and all four TMS Diversity in the Minerals, Metals, and Materials Summits, held in 2014, 2016, 2018, and 2022

Public & Governmental Affairs Director

Michael Titus

Purdue University

Michael Titus is currently assistant professor of materials engineering at Purdue University. Prior to joining Purdue, he was an Alexander von Humboldt Postdoctoral Fellow (Max Planck Institute for Iron Research, 2015–2016), earned his Ph.D. in materials (University of California, Santa Barbara, 2015), and earned his B.S. in engineering physics (The Ohio State University, 2010).

Titus's current research focuses on understanding atomic-level processes that govern high-temperature deformation in structural alloys, and accelerated discovery of materials ranging from shape-memory alloys to refractory complex, concentrated alloys. He and his research group utilize a variety of experimental and computational techniques—from casting to density functional theory—to bridge physical phenomena across length- and time-scales and have published over 30 peer-reviewed articles as part of these efforts.

Titus has been recognized with a U.S. National Science Foundation CAREER Award (2018); TMS Structural Materials Division Young Leaders Professional Development Award (2018); Outstanding Mentor of Engineering Graduate Students, College of Engineering, Purdue University (2019); and as a TMS Young Leaders International Scholar with the Japan Institute of Metals and Materials (2020).

Throughout the past seven years, Titus has been involved in numerous TMS activities. He organized or co-organized seven TMS Annual Meeting and Materials Science & Technology Conference technical symposia. He has served as a member of the High Temperature Alloys Committee since 2015, as faculty advisor of Purdue's Material Advantage chapter since 2019, and as the Public & Governmental Affairs Committee representative (2018–2020) and vice-chair (2020–2023). Recently, he was part of the lead team for the TMS study, *Defining Pathways for Realizing the Revolutionary Potential of High Entropy Alloys*.

Professional Development Director

Kester Clarke

Colorado School of Mines

Kester Clarke is an associate professor in the Metallurgical and Materials Engineering Department at Colorado School of Mines and serves as the Forging Industry Education and Research Foundation Professor. He holds a joint appointment as a scientist at Pacific Northwest National Laboratory, is a visiting scientist at Los Alamos National Laboratory (LANL), and serves as the industry liaison officer for the Center for Advanced Non-Ferrous Structural Alloys. His research interests include alloy development, material deformation and fabrication processes, and the use of experimental and modeling methods to examine the effect of material processing history and microstructure on mechanical properties and performance.

Clarke holds a B.A. in psychology from Indiana University, a B.S. in materials science and engineering from Wayne State University, and an M.S. and Ph.D. in metallurgical and materials engineering from the Colorado School of Mines. He has worked as a consulting metallurgical engineer for Engel Metallurgical and as a senior engineer, research and development, for Caterpillar. He conducted postdoctoral research and was a scientist/R&D engineer in the Materials Science & Technology: Metallurgy group as the technical lead for thermal-mechanical processing of metals and metal component fabrication at LANL.

He is currently the chair of the TMS Education and Steels Committees, was previously the chair of the TMS Shaping & Forming Committee, and is a member of the TMS Phase Transformations; Nuclear Materials; and Diversity, Equity, and Inclusion Committees. He has served as a *Metallurgical and Materials Transactions* key reader since 2011, was part of the study team for the TMS study *Metamorphic Manufacturing: Shaping the Future of On-Demand Components,* and serves as a mentor in the TMS Leadership Development Initiative.

Extraction & Processing Division Chair

Elsa Olivetti

Massachusetts Institute of Technology

Elsa Olivetti is the Esther and Harold E. Edgerton Career Development Professor in the Department of Materials Science and Engineering and co-director of the Climate and Sustainability Consortium at the Massachusetts Institute of Technology (MIT). Her research focuses on reducing the significant burden of materials production and consumption through increased use of recycled and waste materials; informing the early-stage design of new materials for effective scale up; and understanding the implications of policy, new technology development, and manufacturing processes on materials supply chains.

Olivetti received her B.S. in engineering science from the University of Virginia in 2000 and her Ph.D. in materials science engineering from MIT in 2007.

Her TMS activities include serving as the current vice chair of the TMS Extraction & Processing Division; as a lead organizer for the REWAS 2022 symposium at the TMS 2022 Annual Meeting & Exhibition in Anaheim, California; and as the recipient of the 2019 Early Career Faculty Fellow Award. She was also the inaugural recipient of the TMS Sadoway Materials Innovation and Advocacy Award from TMS in 2022.

Functional Materials Division Chair

Saryu Fensin

Los Alamos National Laboratory

Saryu Fensin is a scientist and team leader in the Quasi-Static and Dynamic Loading Team within the Materials Science and Technology Division at Los Alamos National Laboratory. She received her Ph.D. in materials science and engineering from the University of California, Davis.

She has been a TMS member since 2010 and has helped organize multiple symposia at TMS annual meetings, like the Dynamic Behavior of Materials Symposium, the Deformation and Transitions at Grain Boundaries Symposium, and the Hume-Rothery Symposium. Additionally, she has led special topic *JOM* issues as a guest editor related to some of these symposia. She has also served as chair for the TMS Young Professionals, Professional Development, and the Mechanical Behavior of Materials Committees. Additionally, she has served as an active representative/member on functional committees like the Programming; Diversity, Equity, and Inclusion; and Public and Governmental Affairs Committees. She was the chair and TMS representative to the Program Coordinating Committee for the Materials Science & Technology 2021 technical meeting and exhibition. She has been the vice-chair of the Functional Materials Division (FMD) since 2020.

In addition to her service to TMS, she is a recognized authority in the area of dynamic behavior of materials specifically related to metals and alloys. Her research has especially focused on the role of heterogeneities and defects on failure in metals and alloys. She has also been recognized for her leadership through multiple awards and accolades, which include the TMS FMD Young Leaders Award in 2014, the Young Leaders International Scholar Award with the Japan Institute of Metals and Materials in 2016, and the AIME Robert Lansing Hardy Award for her insights into the role of grain boundaries in damage in failure in 2019.

2022 TMS Board of Directors

The current members of the TMS Board of Directors, installed at the conclusion of the TMS 2022 Annual Meeting & Exhibition in March, are:

OFFICERS

President
W. Jud Ready
Principal Research Engineer, Georgia Institute of Technology

Vice President
Brad Boyce
Distinguished Member of the Technical Staff, Sandia National Laboratories

Past President
Ellen Cerreta
Division Leader, Los Alamos National Laboratory

Financial Planning Officer
Charles Ward
Chief of the Manufacturing and Industrial Technologies Division, U.S. Air Force Research Laboratory's Materials and Manufacturing Directorate

TMS Secretary (non-voting)
James J. Robinson
Executive Director, TMS

FUNCTIONAL AREA DIRECTORS

Content Director
Judy Schneider
Professor, University of Alabama at Huntsville

Membership & Student Development Director
Viola Acoff
Associate Dean, University of Alabama

Professional Development Director
David Bourell
Temple Foundation Professor, University of Texas

Programming Director
Timothy Rupert
Associate Professor, University of California, Irvine

Public & Governmental Affairs Director
Eric N. Brown
Executive Advisor, Los Alamos National Laboratory

TECHNICAL DIVISION DIRECTORS

Extraction & Processing Division Director
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Senior Advisor, Norwegian University of Science and Technology

Functional Materials Division
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Associate Professor, University of Pittsburgh

Light Metals Division Director
Edward Williams
Director of Manufacturing Technology, Arconic

Materials Processing & Manufacturing Division Director
Paul Mason
President, Thermo-Calc Software Inc.

Structural Materials Division Director
Suveen Mathaudhu
Professor, Colorado School of Mines

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Meet Paul Krajewski, Children's Book Author

Kelly Zappas

"The opportunity to teach and get kids excited about science and technology is really cool."
—Paul Krajewski

At the General Motors (GM) Research and Development Center, TMS member Paul E. Krajewski leads the Vehicle Systems Research Lab. His laboratory focuses on a variety of things that aren't necessarily materials-related—such as connectivity, autonomous driving, and lunar mobility vehicles—but are all, in Krajewski's words, pretty neat stuff from an R&D perspective.

Despite this interesting work, there is one thing that he misses.

"When you go into industry, the one gap is that you don't get a chance to teach—at least that's the way it was for me," said Krajewski, who holds a doctorate in materials science and engineering from the University of Michigan. "It's always something I've enjoyed, from back when I was a graduate student. That opportunity to teach and get kids excited about science and technology is really cool."

A fun way to pass on that excitement and knowledge, Krajewski thought, would be to write a book for children.

"It's always been something that was on my mind, but you get busy with life, and you don't get around to it," he said.

Then one year, at Christmas, he started talking with his brother-in-law, middle-school teacher Matthew N. Topper, about the idea. "So we thought, 'What the heck? Let's try it!'"

From that one conversation grew a collaboration that has so far resulted in three books designed to interest young people in the STEM fields: *What's in Your Car: A Poetic Ride through the Periodic Table* (published in 2016); *What's in Your Body: A Poetic Examination of the Periodic Table* (published in 2020); and *What's in Your Plane* (planned for publication in summer 2022). While the topics range from physical science to biology, they are tied together by a single theme: the periodic table of elements.

Co-authors Matthew N. Topper (left) and Paul E. Krajewski (right).

This article is part of an occasional feature series in which *JOM: The Magazine* shares stories about members and their hobbies, interests, and experiences outside of their TMS membership. To suggest a candidate for this feature, contact *JOM: The Magazine* Principal Editor Kaitlin Calva at kcalva@tms.org.

The Books

Each of the three books starts with an illustration of the periodic table of elements before walking the reader through a selection of elements and how they play into the book's theme. They started with subject matter that Krajewski knows well: cars.

What's in Your Car, their first book, contains 31 poems that describe select elements and the roles they play in cars. Each element gets its own page, along with photos and interesting facts.

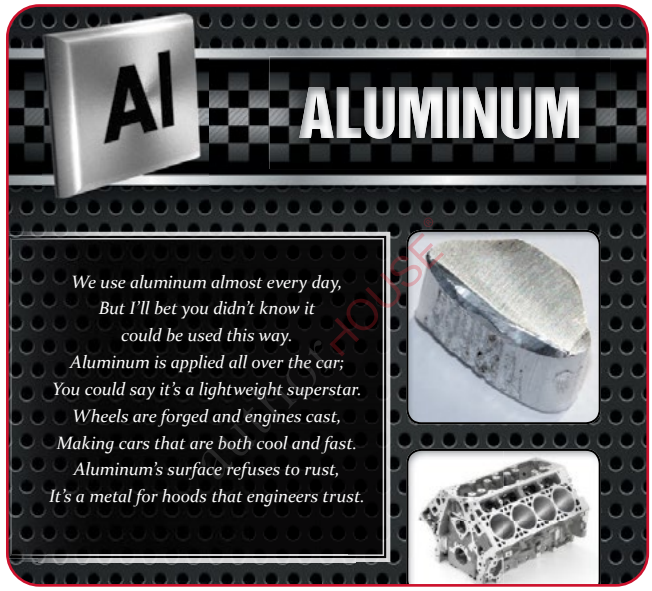
"I have the materials science background so I do all the initial research," Krajewski said. "I start with the car, look at all the elements, and figure out what we're going to do." After that, he and Topper go back and forth working on the poems.

Each of the books follows this same format to illustrate the uses of various elements, but the design of the books has varied slightly for each installment.

"For the first one, which we self-published, we did the design and had to find all the pictures and get permission to use them," said Krajewski. For the third book, *What's in Your Plane,* they are working with a new publisher, who is handling all of the design and the pictures.

"They are more focused on visual aesthetics," he said of the new publishers. "The engineer in me was saying, 'This needs to be exactly representative,' but they're taking the approach of 'This picture looks amazing.' It's a totally different vibe for the new one."

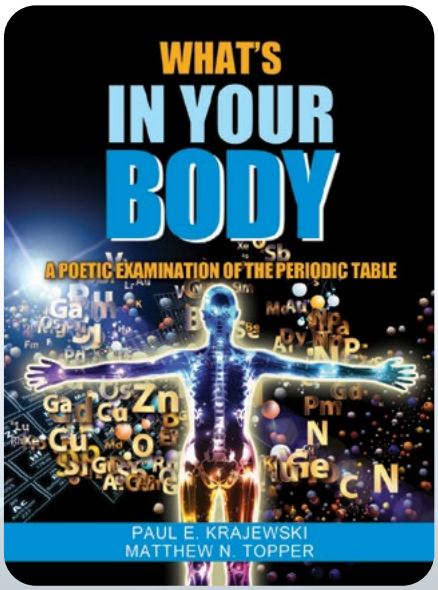
For this newest book, Krajewski also sourced some of his images from the materials science and engineering community. Through LinkedIn and some of his professor colleagues, he sent out a call for images, particularly from students. "We want to give students around the world the opportunity to have their micrographs included in our books," his request stated. He solicited images of either pure elements or alloys or compounds which include the elements, produced by optical, scanning electron microscopy, transmission electron microscopy, or other techniques.

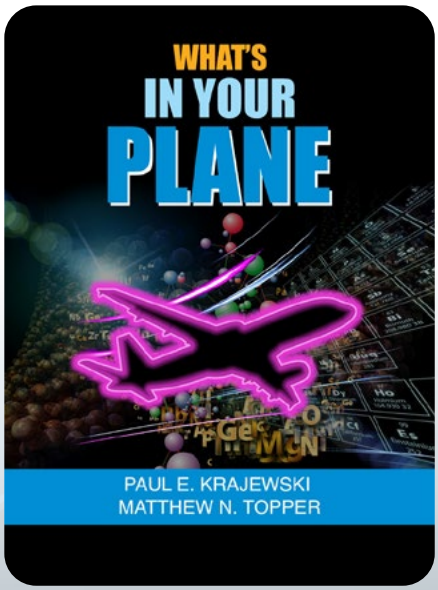


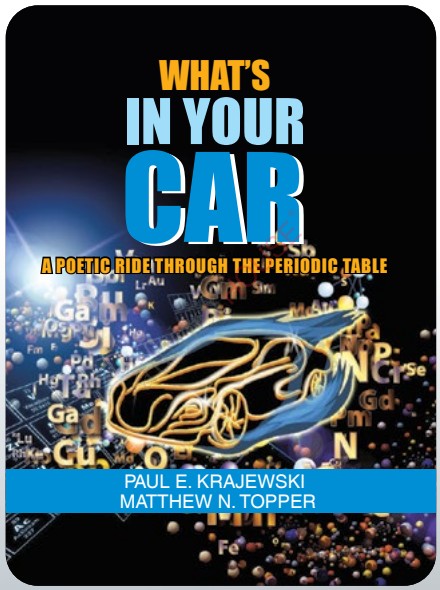
Krajewski and Topper developed poems such as this one (from *What's in Your Car*) to relate the elements to cars, planes, and the human body in their three children's books.

"This book tells the story
of what's in a car.
From aluminum to zinc,
they help you drive far.
So buckle your belt
and adjust your view.
Here's a book about elements
in a car just for you."
—What's in Your Car: A Poetic Ride through the Periodic Table

Krajewski and Topper's first three books, pictured below, are available for purchase through Amazon, Barnes & Noble online, and other online booksellers. (Please note that at press time, *What's in Your Plane* was not yet available for purchase.)







A total of four images were ultimately selected and included—with credit to each student and their university—in *What's in Your Plane.* Krajewski hopes to get even more participation from the broader community for future books.

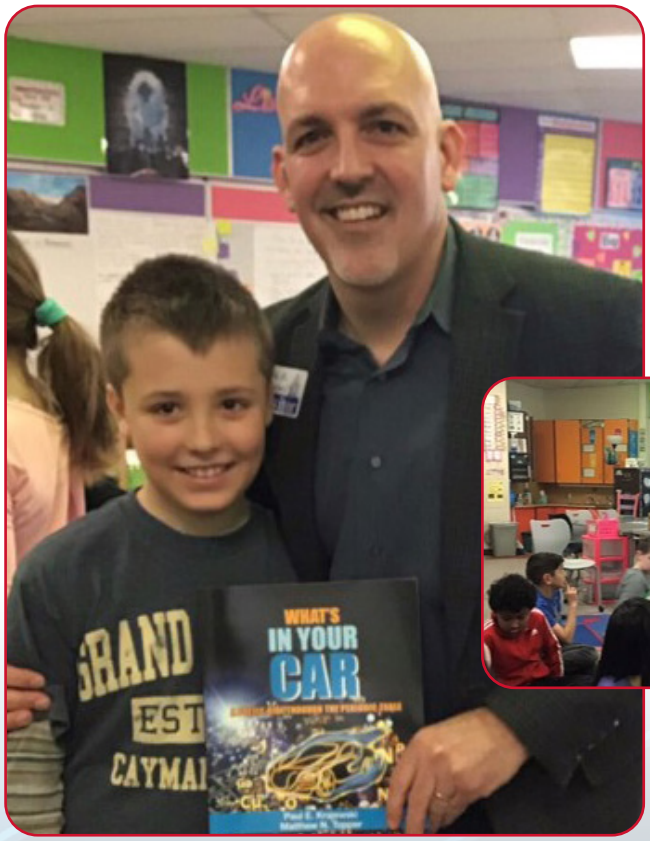
The Audience

Because Krajewski and Topper developed and published the books themselves, their next step was to get the books to their intended audience: young readers. One way they have done this is through school visits.

"We're not trying to get rich," said Krajewski, who notes that they paid to have the books created, so they take the books into schools to share with students and to create enthusiasm for science and engineering topics.

"I have a whole kit full of stuff I take in for these visits," he said. "I have pieces of aluminum foam and shape-memory alloy toys, as well as samples of gold and platinum. I have a container with sulfur in it so the kids can open it up and smell it. That's as interesting to them as the book. They love it."

Inevitably, the most popular parts of the books, with young audiences, are the ones that Krajewski describes as "the fifth-grade boy" sections. "Every book has at least one poem with something referring to poop or farts or something kid-like. It's just fun, and the kids always giggle about it," he said.



Krajewski shares *What's in Your Car* at an author visit to his son's school.

"It's been a fun, labor-of-love opportunity more than anything else."
—Paul Krajewski

Although he has gone on only a handful of school visits so far—his job keeps him too busy for much more than that—Krajewski was also able to share these samples and distribute copies of the books at GM's take your child to work day.

"Maybe someday, when I retire, this will become a thing I can spend more time on—going into schools and sharing these books," said Krajewski. "It's been a fun, labor-of-love opportunity more than anything else."

What's Next

The series won't end with the soon-to-be-released *What's in Your Plane.* Krajewski and Topper have already drafted text for *What's in Your Car 2* and are planning on following that up with volumes that look at elements found in electronic devices and in sports equipment.

"*What's in Your Device*—that's an easy one. Just look at all the materials in your cell phone. There's all kinds of stuff there," he said, while pointing out that a book about sports would allow them to explore materials in golf clubs, tennis rackets, and other equipment.

Krajewski has also considered adding videos to complement the print publications and creating Spanish versions of the books to get kids from other countries excited about science and engineering as well.

"There are a lot of grand ideas, just not the time to do them," said Krajewski. "We have day jobs. We do this in our free time, and in many ways, I view it as an investment for the future. When we retire, it would be a great thing to just spend time interacting with kids and getting them excited about these topics."

Editor's Note: *Krajewski has been a TMS member since 1993 and is currently a member of the TMS Shaping and Forming Committee under the Materials Processing & Manufacturing Division. He received the 2013 AIME Champion H. Matthewson Award and was a member of the first class of TMS Brimacombe Medalists in 2012. In 2020, Krajewski was elected to the National Academy of Engineering.*

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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?

JOM THE MAGAZINE

Submit your announcement or press release to Kaitlin Calva, *JOM: The Magazine* Principal Editor, at kcalva@tms.org for consideration.

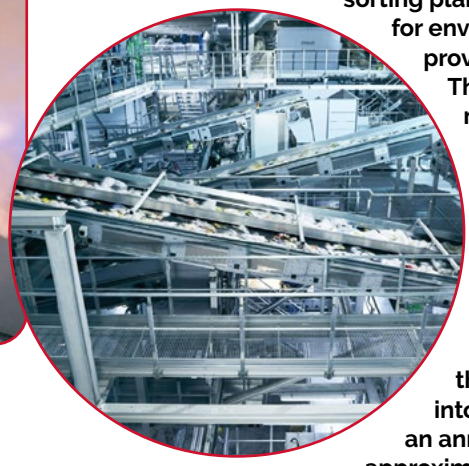
Concord, Ontario, Canada: Prodevco Robotic Solutions updated its PCR42 system, the company's advanced robotic plasma steel cutter, to accommodate larger beams. The standard system can now process beams up to 40 inches, while optional upgrades allow for up to 48-inch beams. The PCR42 combines plasma cutting and torch technology with fully automated robotics and laser measuring systems. The robot provides structural steel cutting that blends speed, precision, and a complete seven-axis operation. It can cut features onto four face profiles including slots, holes, and markings. (Photo Credit: Prodevco Robotic Solutions)

Li-Cycle Partners in Battery Recycling

Toronto, Ontario, Canada: Li-Cycle Holdings Corporation is partnering with Veolia Water Technologies to provide HPD crystallization technology for the battery recycling process at a lithium-ion battery recycling plant in Rochester, New York. Veolia's technology allows a recycler to optimize the creation of nickel sulfate and cobalt sulfate from lithium-ion batteries and transforms them into high-purity raw materials, ready to be used in new batteries. When fully operational in 2023, they expect to help recycle around 225,000 electric vehicle batteries per year.

New Collaboration to Clean Up Bauxite

Boucherville, Quebec, Canada: Geomega Resources Inc., a developer of clean technologies for the mining, refining, and recycling of critical materials, announced that Innord Inc., its wholly owned subsidiary, has signed a term sheet with Rio Tinto to enter into a development agreement for Bauxite Residues Iron Phase Product. Rio Tinto will provide one million dollars in funding for Innord to complete the required proof-of-concept work and the subsequent small-scale locked cycle pilot plant at its Boucherville facilities.



Altshausen, Germany: STADLER designed and installed an advanced light packaging sorting plant in Eitting, Germany, for environmental service provider PreZero Recycling. The new facility is the most advanced light packaging sorting plant in Europe, capable of sorting the packaging fractions by color and filtering black plastics. The results are extremely high-quality materials that can be recycled into new products. With an annual throughput of approximately 120,000 tons, it is the biggest light packaging plant in Europe. (Photo Credit: STADLER)

Lincoln Electric Printed Urgent Parts

Cleveland, Ohio, USA: Lincoln Electric harnessed its proprietary metal 3D printing technology to deliver just-in-time components to Chevron USA after it had undergone a routine maintenance shutdown. With supply chain delays extending the lead times of traditionally manufactured parts, Chevron's planned restart schedule was disrupted. By working with Lincoln Electric, and by leveraging its wire-based metal additive manufacturing technology, the company was able to print critical replacement parts that met both production and quality standards. The eight parts were printed in a nickel alloy across a 30-day timeframe and averaged approximately three feet in length and over 500 lbs in weight.

Advanced Metal Processing Lab Opens

Irvine, California, USA: The University of California, Irvine held a grand opening celebrating the completion of a metal processing facility for its Advanced Casting Research Center (ACRC). The new lab includes a modern foundry, a vacuum melting system, and a complete Spectro lab for chemical analysis, along with other state-of-the-art features. The ACRC is one of the largest industry-university consortia in North America dedicated to collaborative research in metal processing and manufacturing. Founding director of ACRC, Diran Apelian was instrumental in the facility's creation.

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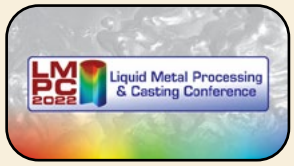
TMS MEETING HEADLINES

JOM THE MAGAZINE

Meeting dates and locations are current as of May 17, 2022.
For the most recent updates on TMS-sponsored events, visit **www.tms.org/Meetings**.

Additive Manufacturing Benchmarks (AM-Bench) 2022
August 15–18, 2022
Bethesda, Maryland, USA
Housing Deadline: July 22, 2022
AM-Bench 2022 will provide a continuing series of controlled benchmark measurements, in conjunction with a conference series, with the primary goal of enabling modelers to test their simulations against rigorous, highly controlled additive manufacturing benchmark test data.
www.tms.org/AMBench2022



2022 Liquid Metal Processing & Casting Conference (LMPC 2022)
September 18–21, 2022
Philadelphia, Pennsylvania, USA
Discount Registration Deadline: August 8, 2022
LMPC 2022 is a unique event that will showcase the latest technological and scientific advances related to those industrial processes used to cast large ingots of highly alloyed metals.
www.tms.org/LMPC2022

Materials Science & Technology 2022 (MS&T22)
October 9–13, 2022
Pittsburgh, Pennsylvania, USA
Register Now
Beginning this year, MS&T will co-locate with two exhibitions: The Advanced Materials Show and The Nanotechnology Show. Additionally, the Society for Biomaterials has joined MS&T as an event partner, sponsoring three symposia in addition to the more than 80 symposia in 15 technical tracks already planned for MS&T22.
www.matscitech.org/MST22

Superalloy 718 & Derivatives 2023
May 14–17, 2023
Pittsburgh, Pennsylvania, USA
Manuscript Deadline: September 16, 2022
The Superalloy 718 & Derivatives 2023 conference is a meeting to explore all aspects of metallurgical processing, materials behavior, and microstructural performance for a distinct class of 718-type superalloy and derivatives. Technical topics will cover broad industrial applications for a cross-section of industries, including supply chain, energy, and aerospace.
www.tms.org/Superalloy718-2023

Other Meetings of Note

TMS 2023 Annual Meeting & Exhibition
March 19–23, 2023
San Diego, California, USA
www.tms.org/TMS2023

TMS 2024 Annual Meeting & Exhibition
March 3–7, 2024
Orlando, Florida, USA
www.tms.org/TMS2024

TMS 2025 Annual Meeting & Exhibition
March 23–27, 2025
Las Vegas, Nevada, USA
www.tms.org/TMS2025

2022 Annual International Solid Freeform Fabrication Symposium
July 25–27, 2022
Austin, Texas, USA

COPPER–COBRE 2022 (Copper 2022)
November 13–17, 2022
Santiago, Chile
Co-sponsored by TMS

ALTA 2023 Metallurgical Conference
April 30–May 6, 2023
Perth, Australia

OTC Brasil 2023
October 24–26, 2023
Rio de Janeiro, Brazil
Co-sponsored by TMS

Thermo-Calc Software

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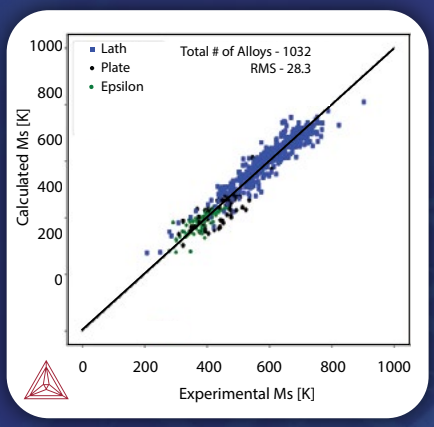
- ✓ **Fill in** data gaps without resorting to costly, time-consuming experiments
- ✓ **Predict** how actual vs nominal chemistries will affect property data
- ✓ **Base Decisions** on scientifically supported models
- ✓ **Accelerate** materials development while reducing risk
- ✓ **Troubleshoot** issues during materials processing

Over 40 Thermodynamic and Kinetic Databases

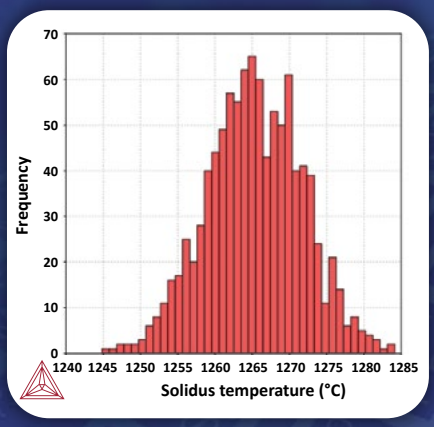
Choose from an extensive selection of thermodynamic and mobility databases in a range of materials, including:

Steel and Fe-Alloys



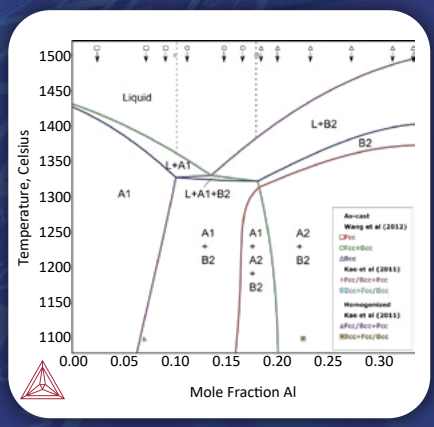
Comparison of calculated and experimental Ms temperatures for a wide range of steels

Nickel



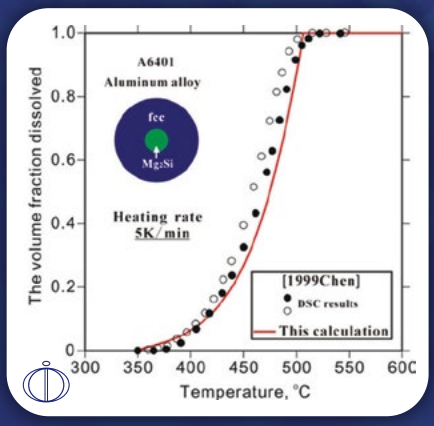
Variation in solidus temperature over 1000 compositions within alloy 718 specification

High Entropy Alloys



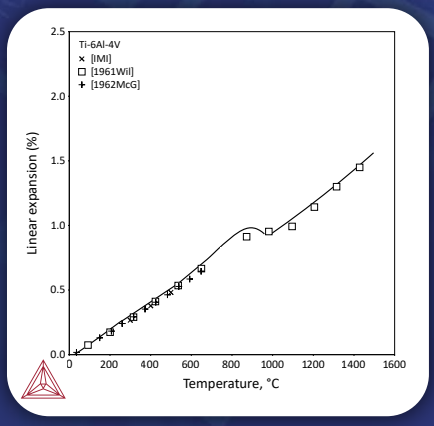
Calculated phase diagram along the composition line of CoCrFeNi-Al

Al Alloys



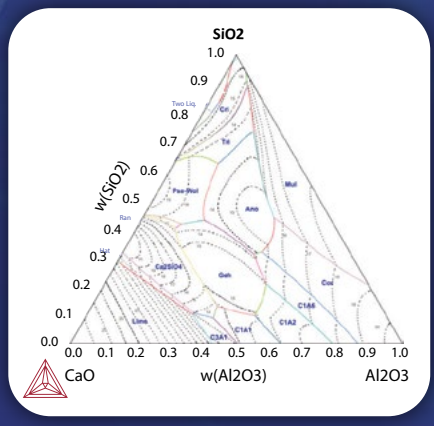
Dissolution of Mg2Si precipitate in Alloy A6401

Ti and TiAl Alloys



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

Oxides



Ternary liquidus projection in oxide systems

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