FEBRUARY 2022
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JOM THE MAGAZINE

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

Celebrating Black History Month:

Four Pioneers Who Changed the Materials Science Game

Together Again: Read the MS&T21 Recap

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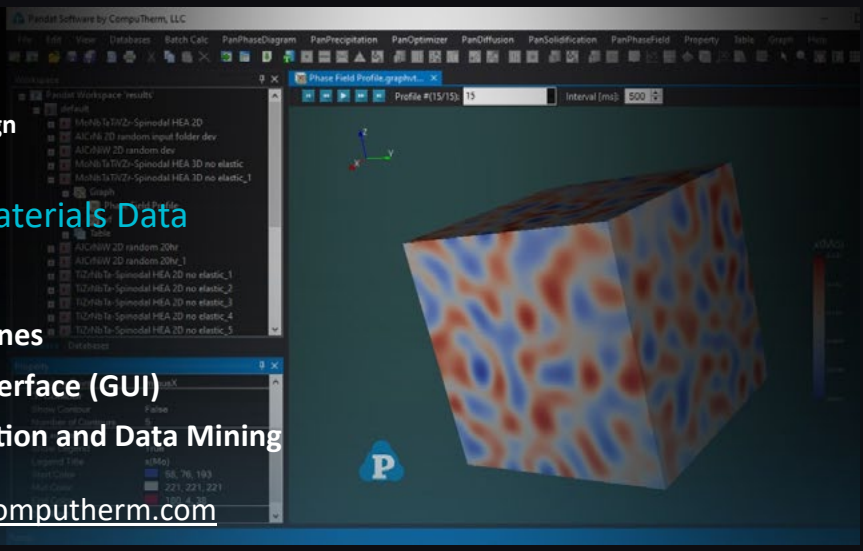

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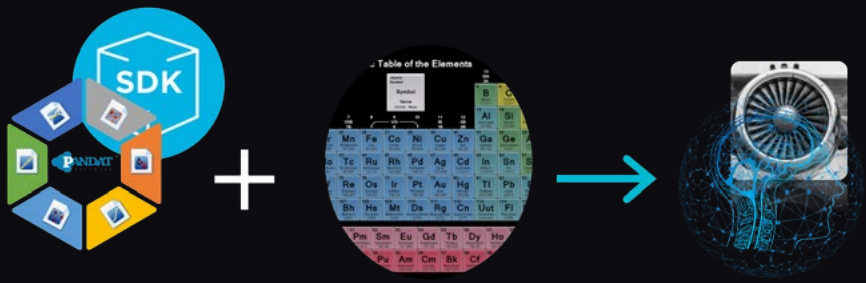

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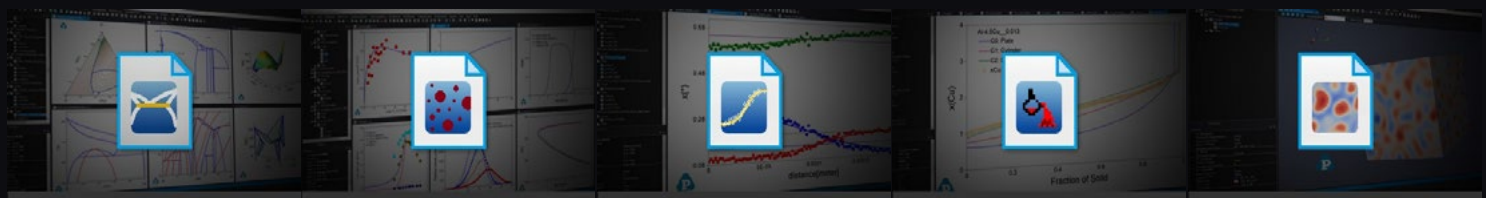

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- property contour diagrams
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- chemical driving force

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

PanDiffusion

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- homogenization
- carburization and decarburization
- particle dissolu-tion

PanSolidification

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- 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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ABOUT THE COVER

JOM: The Magazine celebrates Black History Month with a special series from the TMS Diversity, Equity, and Inclusion Committee that highlights African American pioneers in the materials science and engineering field. The photos on this month's cover features, left to right: Robert Henry "Pete" Bragg Jr. (photo © 2010 The Regents of the University of California, Lawrence Berkeley National Laboratory); Bettye Washington Greene (photo credit: Dow Chemical, courtesy of Science History Institute); William Jacob Knox Jr. (photo credit: Harvard University Archives); and Lawrence Knox (photo credit: The Edmund S. Muskie Archives and Special Collections Library). These four pioneers are rendered in a stylized line art with a background inspired by African-American color field painter and lyrical abstractionist artist, Sam Gilliam.

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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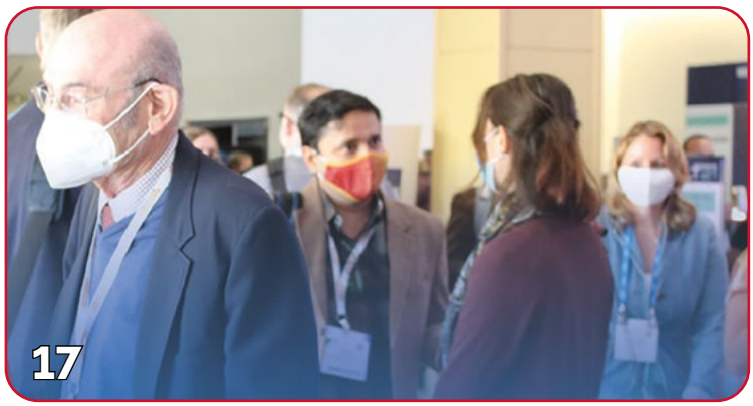
TABLE OF CONTENTS

JOM Volume 74 Number 2 February 2022

FEATURES

DEPARTMENTS



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IN THE FINAL ANALYSIS

JOM THE MAGAZINE

"We don't see things as they are, we see them as we are."
—Anonymous but commonly ascribed to Anaïs Nin, Steven Covey, the Talmud, and many others

Volume 74
Number 2
February 2022

James J. Robinson
Executive Director
@JJRofTMS

It has been widely communicated within TMS that the Society's strategic plan is designated "TMS Aspires," and the first goal within that plan is "TMS aspires to be a highly inclusive society where all materials students and professionals feel welcome and diversity is celebrated." It is a rallying goal. In the 2010s and now 2020s, TMS has pursued Goal 1 with vigor via words and action and will continue to do so.

I know with certainty that much exceptional and meaningful work has been done within TMS to advance Goal 1. Am I biased in my assessment? Perhaps a bit as I'm the TMS Executive Director, but we all have some biases that we try to work past to better see what is real, right? Now, while people can be biased, what about a materials-focused professional society? In 2020, the TMS Board of Directors asked that very question. To explore it, the Board commissioned the ad hoc Committee on Potential Biases within the Society Culture. Chaired by 2020 TMS President Thomas Battle, the ad hoc committee took its job seriously and worked with rigor. It delivered an in-depth report to the Board as part of TMS2021 Virtual.

At a high level, the committee "did not find evidence of explicit, conscious bias directed to any specific group. However, there is indication of the existence of implicit, unconscious bias that may interfere with the full engagement of many TMS members in the life of the Society." To address these issues, a suite of recommendations followed. The Board took the report and recommendations and worked with staff to develop an implementation plan, and that plan was approved at MS&T21.

The new plan works in complement to TMS Aspires, being called "TMS Resolves." At the highest level, it reflects the intent of the Society to abolish long-standing processes and cultural norms within TMS that pose significant barriers to the engagement of members who do not have ties to established groups.

TMS Resolves contains four goals and 17 tactics. It assigns tactical oversight to appropriate volunteer functional committees throughout the Society and identifies metrics by which to track progress on the tactics. The TMS Resolves goals are:

1. TMS Resolves to Diversify the TMS Community
2. TMS Resolves to Infuse TMS Norms and Culture with Inclusionary Practices
3. TMS Resolves to Train TMS Volunteers to Be Effective and Inclusive Leaders
4. TMS Resolves to Bring Equity to Committee Engagement by Virtualization and Other Tools

How to do that? The tactics cluster into the following broad areas:

1. Coaching existing and emerging volunteer leadership to better recruit, engage, mentor, and orient new and existing volunteers
2. Recruiting and engaging more—and more diverse—members in TMS volunteer activities
3. Training and enabling TMS members to be more effective and inclusive in their volunteer activities
4. Orienting TMS members as to Society best practices, a culture of mentorship, bias-free communication, and avoidance of unconscious bias
5. Developing new volunteer opportunities and using virtual tools to enable wider engagement

I'm enthusiastic to be among the staff and volunteers who will implement TMS Resolves. I am confident that you will see many tangible results in the Society's not-to-distant future.

"In the 2010s and now 2020s, TMS has pursued Goal 1 with vigor via words and action and will continue to do so."

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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.

FEBRUARY 2022

2D Materials—Preparation, Properties & Applications

Scope: Since the discovery of graphene, interest in basic and applied research in 2D materials is on the rise. Challenges and opportunities continue to grow in the areas of process-property-performance correlations in 2D materials. Efforts to transfer technology from fundamental R&D to prototyping to manufacturing are being pursued rigorously on a global scale. Studies on carbon nanotubes, graphene, hexagonal boron nitride, perovskites, phosphorene, transition metal dichalcogenides, xenes (germanene, silicene, stanene) are covered.

Editors: **Nuggehalli Ravindra**, New Jersey Institute of Technology; **Ramana Chintalapalle**, University of Texas at El Paso; **Gerald Ferblantier**, Strasbourg University; **Sufian Abedrabbo**, Khalifa University; and **Amber Shrivastava**, Indian Institute of Technology Bombay

Sponsor: Thin Films and Interfaces Committee

Artificial Intelligence and Machine Learning in Energy Storage and Conversion Materials

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

Editors: **Simona Hunyadi Murph**, Savannah River National Laboratory, and **Surojit Gupta**, University of North Dakota

Sponsor: Energy Conversion and Storage Committee

Characterization of Waste-Derived Materials

Scope: This topic covers the latest achievements in exploration of novel value-added materials derived from various wastes. Of particular, interest are papers on characterization and modification for those originated from mineral/metallurgical/material processing. Of interest are multifunctional slag/tailing-based materials with unique combinations of desirable thermo-mechanical-chemical performance for sustainable industrial and municipal applications.

Editors: **Zhiwei Peng**, Central South University; **Yunus Eren Kalay**, Middle East Technical University; **Rajiv Soman**, Eurofins Scientific; and **Jian Li**, CanmetMATERIALS

Sponsor: Materials Characterization Committee

Exploring the Relationships Between Plastic Deformation and Heat

Scope: This topic will explore experimental, computational and theoretical methods to understand heat generation and heat transfer in materials, through the interactions between phonons, electrons, and dislocations. Manuscripts examine factors (composition, microstructure, etc.) that determine the fraction of work converted into heat, mechanisms of converting deformation to heat, role of "phonon radiation" of dislocations as they move at high velocities, etc. Novel experimental and computational approaches that enable determination of temperature/heat-generation in the plastic deformation zone are also of interest.

Editors: **Aashish Rohatgi**, Pacific Northwest National Laboratory; **Sean Agnew**, The University of Virginia; and **Thomas Bieler**, Michigan State University

Sponsor: Shaping and Forming Committee

Surface Engineering for Improved Corrosion or Wear Resistance

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

Editors: **Tushar Borkar**, Cleveland State University; **Arif Mubarok**, PPG Industries; and **Rajeev Gupta**, The University of Akron

Sponsor: Surface Engineering Committee

Technology Metals in the Circular Economy of Cities

Scope: The need for technology metals such as precious metals, rare earths, and minor metals (Sb, Co, etc.) will continue to increase. However, the recycling rate of these metals is inadequate. This special topic focuses on innovative recycling technologies that would improve recovery rate of these technology metals from municipal waste streams (MWSs). Manuscripts that address waste treatment and life cycle assessments pertaining to the (potential) recovery of technology metals from MWSs were invited.

Editors: **Fiseha Tesfaye**, Åbo Akademi University; **Joseph Hamuyuni**, Metso Outotec; **Chukwunwike Iloeje**, Argonne National Laboratory; and **Alexandra Anderson**, Gopher Resource

Sponsors: Recycling and Environmental Technologies Committee, Energy Committee, and Process Technology and Modeling Committee

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A Celebration of History, Scientific Progress, and Pioneers Who Revolutionized Materials Science

Jonathan D. Madison

Carter G. Woodson initiated Negro History Week in 1926 as a celebration of the culture, accomplishments, and history of African Americans. Contrary to popular belief, Woodson never believed the recognition or study of African Americans should be relegated to one week. From Negro History Week's inception, Woodson endorsed and encouraged the study of African American contributions year-round and viewed Negro History Week as a dedicated time for students to demonstrate what they had learned throughout the entire year.[1]

This was demonstrated in the unyielding work of Woodson and the organization he created called the Association for the Study of Negro Life and History (ASNLH), later renamed the Association for the Study of African American Life and History (ASALH). Together, Woodsen and his organizaiton would, for years, generate study materials for students, instructional lessons for teachers, theatrical plays for communities, and a variety of content highlighting significant historical events, persons, places, and things. In addition, Woodson and the ASNLH/ASALH would advocate for and champion the observance of Black History throughout the country. In 1976, five decades following the first celebration and 26 years following Woodson's death, the ASALH would succeed in advancing the recognition of African American culture and heritage from a one-week activity to a month-long celebration. In this year, Gerald R. Ford would become the first U.S. President to publicly urge Americans nationally to "seize the opportunity to honor the too-often neglected accomplishments of Black Americans in every area of endeavor throughout our history."[2] With this precedent set, every subsequent U.S. President has issued a proclamation for Black History Month ever since.[2]

CELEBRATE ALL MONTH LONG

Watch TMS social media during Black History Month to continue the celebration of both the historic pioneers featured in this issue of *JOM: The Magazine*, and those who are making history today.

TMS – The Minerals, Metals & Materials Society

@TMSSociety

The Minerals, Metals & Materials Society

@tmssociety

This February, TMS embraces the spirit and intent of the prolific academic, Carter G. Woodson, and celebrates the existence of both historic and modern contributors to the field of materials and materials processing who are both brilliant scientifically and African or African American ethnically. All month, modern trailblazers in the field will be highlighted on TMS' social media channels. Conversely, within this issue of *JOM: The Magazine*, four historic pioneers in the field are highlighted through three articles for their revolutionary scientific contributions.

The first article in this series highlights a celebrated, modern-day pioneer in crystallography and diffraction techniques whose body of work significantly contributed to our understanding of graphite. He would also develop techniques necessary to reveal light elements previously thought to be transparent to x-rays. Among other accolades and appointments, he would serve as a researcher at Lawrence Berkeley National Laboratory and chair for the Materials Department at the University of California, Berkeley.

The second article explores the amazing achievements of two brothers who at the turn of the 20th century would acquire bachelor's, master's, and doctoral degrees from some of the most elite American universities. They would each go on to teach at several Historically Black Colleges and Universities (HBCUs) and then make impressive research impacts to help unlock the secrets of atomic energy in the Manhattan Project. One would even serve as the first and only African American supervisor for an all-white corrosion group supporting the war effort at Columbia University.

The third article features the life and legacy of the first African American woman to be employed by the Dow Chemical Company in a scientific R&D position. She would would build an impressive, life-long career as a particle scientist and polymer chemist. Her discoveries would dramatically impact the pharmaceutical, catalyst, cosmetic, and latex paint industries for generations. Her persistence through trial and adversity are a keen reminder of the challenges and discrimination faced by many African Americans who came before her and many who have followed.

My fellow authors and I hope that these portraits in excellence will serve to highlight just a few of the fantastic achievements made by African Americans in the field. For all people of color who undertake a career in science: while our ethnicity may, in some arenas, categorize us, like all other scientists, it is our intellectual and scientific achievements that define us.

Happy Black History Month.

"A Celebration of History, Scientific Progress, and Pioneers Who Revolutionized Materials Science," serves as an introduction to a thematic group of articles in the February 2022 issue of *JOM: The Magazine*, recognizing the contributions of several African American materials scientists. This special Black History Month article package is a feature series developed by the TMS Diversity, Equity, and Inclusion Committee. For additional information, contact Kaitlin Calva, *JOM: The Magazine* Managing Editor, at kcalva@tms.org.

"For all people of color who undertake a career in science: while our ethnicity may, in some arenas, categorize us, like all other scientists, it is our intellectual and scientific achievements that define us."

Jonathan D. Madison is program director in the Division of Materials Research at the National Science Foundation. A TMS member since 2003, Madison chaired the organizing committee for the third Summit on Diversity in the Minerals, Metals, and Materials Professions. He is currently the chair of the DEI Committee's Race & Ethnicity Working Group.

Editor's Note: *JOM: The Magazine* would also like to thank Tashiema L. Ulrich, R&D associate staff, Los Alamos National Laboratory, for her work as curator on this Black History Month article series. A TMS member since 2020, Ulrich is the *JOM* co-liaison for the Diversity, Equity, and Inclusion Committee.

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https://doi.org/10.1007/s11837-021-05125-8

Table of Contents

R.H. Bragg: An African American Pioneer in X-Ray Crystallography, X-Ray Diffraction, and Materials Characterization

Olivia D. Underwood Jackson and Cyril L. Williams

Robert Henry "Pete" Bragg Jr. Photo credit: © 2010 The Regents of the University of California, Lawrence Berkeley National Laboratory.

Professor emeritus Robert Henry "Pete" Bragg Jr. was a quintessential scientist and champion for people of color in science and engineering. He was one of four children and was born in Jacksonville, Florida, on August 11, 1919. Bragg grew up in Memphis, Tennessee, but later moved to Chicago, Illinois, where he attended Tilden Technical High School. After high school, Bragg studied at Woodrow Wilson Junior College for a couple of years before enlisting in the military during World War II. After the war, he used the money allotted from his G.I. Bill to enroll at the Illinois Institute of Technology (IIT).[1,2] He received his B.Sc. degree in physics in 1949 from IIT and went on to study quantum mechanical scattering theories with Francis L. Yost as his master's thesis advisor. He earned his M.Sc. degree in physics from IIT in 1951.

After graduation, Bragg worked for the Dover Electroplating Company and the Portland Cement Association Research Laboratory, where he developed an expertise in x-ray crystallography and x-ray diffraction. He later worked for five years in the solid-state physics department of the Armor Research Foundation at IIT. During this period, he continued his doctoral studies at IIT working under his mentor, Leonid V. Azaroff, and in 1960 completed his Ph.D. in physics. After earning his Ph.D., he gained employment with the Lockheed Missiles and Space Company, where he later became the manager for the Metallurgy Department.

Bragg was a brilliant and highly skilled scientist in x-ray crystallography, x-ray diffraction, small angle x-ray scattering, and materials characterization. During his professional career, he became an international subject matter expert in characterizing the structure and electronic properties of materials. Bragg was widely noted for his research on eutectic solidification and carbon materials as semiconductors. Perhaps some of his most notable research on carbon materials includes but is not limited to: "Structural Transformations Induced in Graphite by Grinding Through the Analysis of X-Ray Diffraction Line Profiles of the (002) Reflections," "Structural Disorder Induced in Graphite by Grinding," and "Interstitials in Graphite and Disordered Carbon."[3,4,5] His research provided new insights on the structure-property relationships in carbon materials and has strongly influenced how carbon materials are currently used in everyday applications. He also pioneered the use of x-ray diffraction techniques to characterize the structure of complex materials, in particular those containing light elements that were traditionally known to be relatively transparent to x-rays.

After an illustrious career including serving as chair of the Department of Materials Science and Engineering at University of California, Berkeley (UC Berkeley) from 1978 to 1981 and principal investigator in the Materials and Molecular Division at Lawrence Berkeley National Laboratory, Bragg retired from the UC Berkeley faculty in 1987.[1,2] He was the first African American to hold such a position. During his tenure at UC Berkeley, Bragg worked tirelessly to increase the hiring of faculty members of color and concurrently oversaw key diversity programs, including the Chancellor's Minority Fellowship. He was the first sponsor of the Black Engineering and Science Students Association (BESSA) and served on the advisory board of the Black Studies program.

"During his tenure at UC Berkeley, Bragg worked tirelessly to increase the hiring of faculty members of color and concurrently oversaw key diversity programs..."

In addition to his pioneering research in physics, characterization, and materials, Bragg received several honors and distinctions during his career. He was a Fellow of the National Society of Black Physicists (NSBP) and was awarded the IIT Distinguished Alumnus Professional Award. Upon his retirement in 1987, he received the honor of professor emeritus at UC Berkeley. Bragg served as an adviser to the U.S. Department of Energy, the Naval Research Laboratory, the National Science Foundation, and the National Institute of Standards and Technology. He was also a visiting scientist at the University of Bordeaux in France and Mushasi Institute of Technology in Japan. He was awarded a one-year Fulbright Fellowship in 1992 to conduct research at the Obafemi Awolowo University in Nigeria. He also performed research using high-energy x-rays at the Advanced Photon Source at Argonne National Laboratory in 1999. At the age of 98, Bragg passed away on October 2, 2017.

Olivia D. Underwood Jackson is an R&D S&E systems engineer at Sandia National Laboratories. A TMS member since 2013, she is a TMS Foundation Board of Trustees member, a member of the Diversity, Equity, and Inclusion Committee, a member of the Advance Characterization, Testing, and Simulation Committee, and is the 2019 Frank Crossley Diversity Award recipient.

Cyril L. Williams is a senior research engineer and team leader of the Shock Physics Laboratory, Impact Physics Branch, U.S. Army Research Laboratory. Williams has been a TMS member since 2017.

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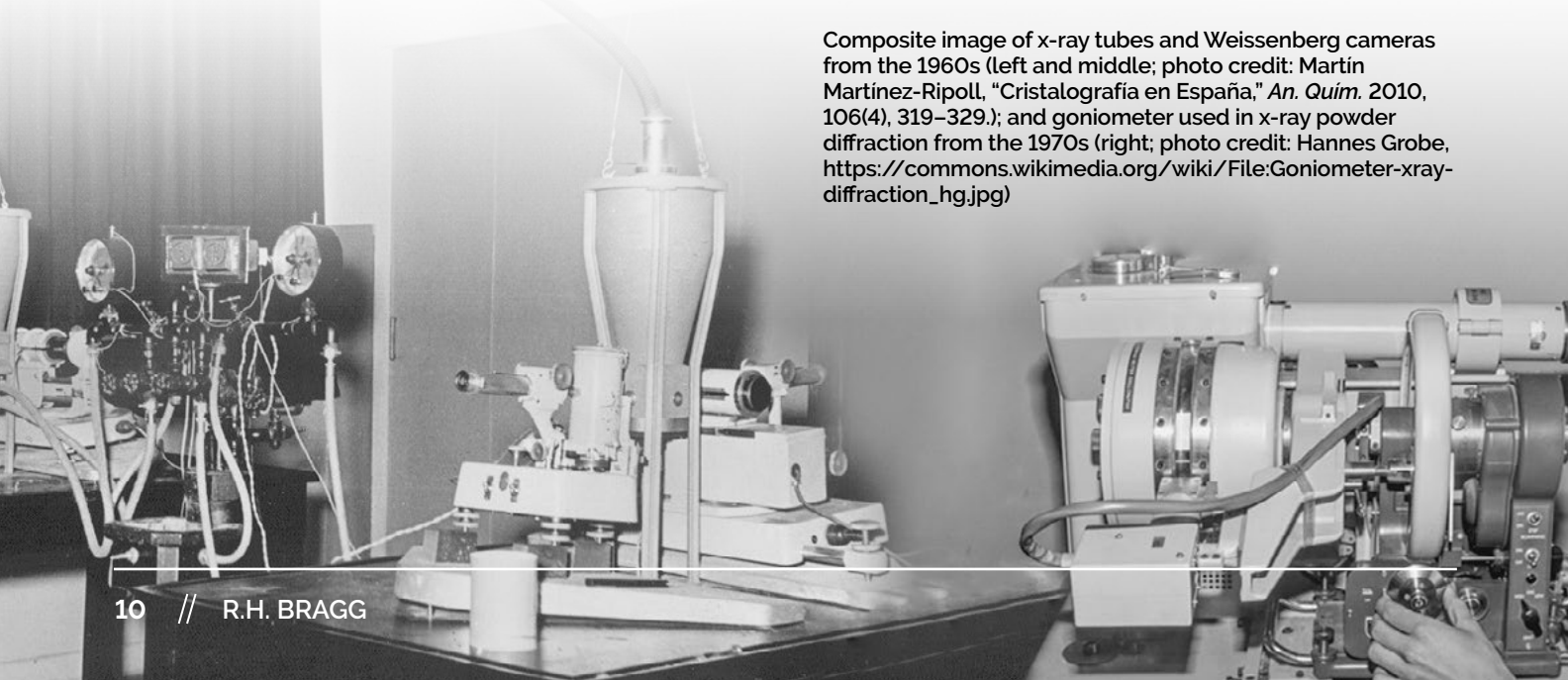

Composite image of x-ray tubes and Weissenberg cameras from the 1960s (left and middle; photo credit: Martín Martínez-Ripoll, "Cristalografía en España," *An. Quím.* 2010, 106(4), 319–329.); and goniometer used in x-ray powder diffraction from the 1970s (right; photo credit: Hannes Grobe, https://commons.wikimedia.org/wiki/File:Goniometer-xray-diffraction_hg.jpg)

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The Knox Brothers: Blackness, Brotherhood, and Scientific Achievement at the Turn of the 20th Century

Jonathan D. Madison and Sharniece Holland

Top: Lawrence Knox (photo credit: The Edmund S. Muskie Archives and Special Collections Library); Bottom: William Jacob Knox Jr. (photo credit: Harvard University Archives).

With a master craftsman as a grandfather, a best-selling author for a grandaunt, and a father who earned the highest score on a civil service exam with little to no formal education, the Knox brothers' academic success demonstrates a commonality still present today.[1] While not a certainty, educational and professional success can often be correlated to a precedent of the same among the forebearers in one's family. However, for Lawrence and William Knox, this is where any and all similarities to others end. The Knox brothers (William, Lawrence, and a third named Clinton) acquired three bachelor's degrees, three master's degrees, and three doctoral degrees from some of the United States' most lauded and prestigious institutions of higher learning, thereby composing 7% of all African Americans to ever receive a Ph.D. in chemistry up to that point..[2,3,4,5] This grand accomplishment is even more remarkable since all this occurred prior to 1940 and their grandfather was, in fact, born into slavery.[1]

William and Lawrence Knox were two of five children born to William Jacob and Estella Knox. These brothers would both go on to receive their doctorates in chemical engineering and organic chemistry from the Massachusetts Institute of Technology (MIT) and Harvard University, respectively. Their brother, Clinton E. Knox, would also go on to earn his Ph.D. from Harvard in European history. Collectively, their nine degrees (bachelor's, master's, and doctoral) were granted by Williams College, Bates College, Brown University, Stanford University, Harvard, and MIT; a rare feat for any three brothers to accomplish by today's standards and an even rarer task for three African American men to accomplish between the years of 1925 and 1940.[6]

Professionally, both William and Lawrence contributed to their fields through both teaching and research. From 1929 to 1941, William taught general, analytical, organic, and physical chemistry at four of the most prestigious of Historically Black Colleges and Universities (HBCUs): Johnson C. Smith University in Charlotte, North Carolina; Howard University in Washington, D.C.; North Carolina Agricultural and Technical College in Greensboro, North Carolina; and Talladega College in Talladega, Alabama. Furthermore, at Talladega, William would go on to become the chair of the Chemistry Department.[7] With limited options for educated African Americans in their era, Lawrence would pursue a similar path. Between 1928 and 1944, Lawrence taught chemistry at Morehouse College in Atlanta, Georgia; North Carolina Agricultural and Technical College in Greensboro, North Carolina; and the North Carolina College for Negroes in Durham, North Carolina.[8]

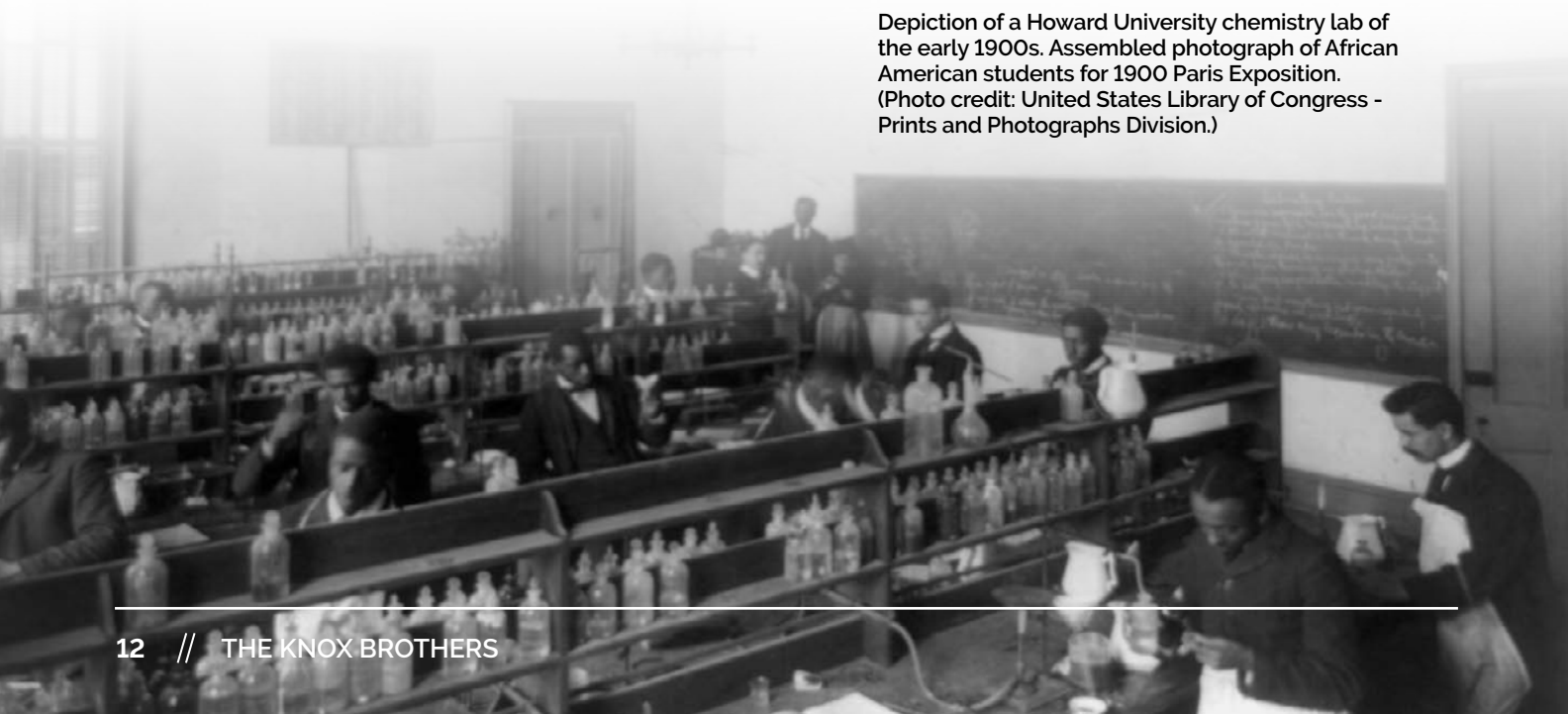
However, like many of their day, World War II would drastically impact the work, livelihood, and professional focus of both William and Lawrence for years to come. In 1943 and 1944 respectively, William and Lawrence would both go on to join the research efforts of the Manhattan Project at Columbia University. While there, William bore the distinction of being the only African American to serve as a supervisor and did so in an all-White corrosion research group, which would make a particularly significant contribution by using gaseous diffusion to improve the isolation of uranium isotopes needed for the atomic bomb.[9] Alternatively, Lawrence's research in quinine would provide the framework for studying radiation and the effects of atomic reactions.[10]

Later in life, William and Lawrence would both go on to further distinguish themselves with extremely well-decorated research careers beyond their time in Columbia's Division of War Research for the Manhattan Project. In fact, Lawrence would go on to work for three separate industrial laboratories in the U.S. and Mexico—Nopco Chemists, Hickrill Chemical Research Foundation, and Laboratorios Syntex—and be granted four U.S. patents in just three years while working for Nopco. Later, he would co-author at least 10 papers and receive 40 patents related to steroid chemistry between the years of 1960 to 1965 while working at Laboratorios Syntex.[4]

Similarly, following his time on the Manhattan Project, William would go on to become the second African American to be hired as a research assistant at Eastman Kodak Company where he was granted 21 patents over a period of 25 years. William's work centered on the use of surface coating surfactants to improve the robustness and quality of photo development.[3] Nine of these patents originally granted to William are still renewed by Kodak today.[11]

Beyond their professional achievements, both William and Lawrence displayed a consciousness for the challenges surrounding them and each responded in their own way. William sought to combat the social ills he witnessed and all too often personally experienced. William, who experienced overt and volatile housing discrimination at multiple points in his life, became an active and vocal member of his local chapter of the National Association for the Advancement of Colored People (NAACP) and also became a founding member of the Urban League of Rochester in New York.[6]

Lawrence's contributions were less motivated by civil rights and social injustice and focused more on mentoring to help develop the next generation of scientists and researchers. During Lawrence's time at Hickrill Chemical Research Foundation, he mentored and trained at least two local teenage interns who would both go on to make significant scientific impact, Maitland Jones Jr. and Caleb Finch. Jones and Finch both recalled the training and amazing patience Lawrence exercised with them as well as the profound impact he had on their relation to science. Jones would go on to become a professor of chemistry and dean of the faculty at Princeton University, and Finch would go on to become a professor and chair of neurobiology at the University of Southern California.[1]



Depiction of a Howard University chemistry lab of the early 1900s. Assembled photograph of African American students for 1900 Paris Exposition. (Photo credit: United States Library of Congress - Prints and Photographs Division.)

Achievements within the laboratory as well as remarkable contributions beyond the bench were no rarity for these two distinguished scientific pioneers. However, it is remarkable to consider, had the United States not entered the war effort when it did and been so desperate to unlock the secrets of atomic energy, how many scientific breakthroughs in modern science, gaseous diffusion, corrosion, and surface chemistry would we have missed out on from the likes of the Knox brothers? An even more humbling question to ask is, how many profound contributions have we been robbed of from others who had the poor misfortune of living in a time wherein the need for their contribution did not outweigh the ignorance and wanton poverty of ideals created and maintained by discrimination, racism, and hatred? The life and contributions of the Knox brothers clearly shows that while brilliance is precious, having an environment where brilliance from all sources can be realized and appreciated is what paves the way for revolutionary scientific breakthroughs.

"The life and contributions of the Knox brothers clearly shows that while brilliance is precious, having an environment where brilliance from all sources can be realized and appreciated is what paves the way for revolutionary scientific breakthroughs."

Jonathan D. Madison is program director in the Division of Materials Research at the National Science Foundation. A TMS member since 2003, Madison chaired the organizing committee for the third Summit on Diversity in the Minerals, Metals, and Materials Professions. He is currently the chair of the the TMS Diversity, Equity, and Inclusion Committee's Race & Ethnicity Working Group.

Sharniece Holland is a lecturer in the McKelvey School of Engineering at Washington University at St. Louis. As a TMS member since 2021, Holland is an active member of the TMS Diversity, Equity, and Inclusion Committee.

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JOM: The Magazine, Vol. 74, No. 2, 2022
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Table of Contents

Bettye Washington Greene: An Industrial Chemist and Inventor Who Lit a Path for Innovation

Clinique Brundidge and Valentino R. Cooper

Bettye Washington Greene. Photo credit: Dow Chemical, courtesy of Science History Institute.

American civil rights pioneer John Lewis once wrote: "You are a light...Never let anyone—any person or any force—dampen, dim or diminish your light." At a time when the civil rights movement was shedding light on inequalities faced by African Americans, Bettye Washington Greene (March 20, 1935–June 16, 1995) was forging a path that would light the way—figuratively and literally—for generations to come. She was one of the first few African American women to earn a Ph.D. in chemistry in the 1960s, an era marked by the passing of the Voting Rights Act of 1965. Washington Greene's doctoral thesis evaluated light-scattering methods to determine the size of particles, which influence molecular effectiveness, activity, and stability. The fundamental knowledge she provided critically aided the pharmaceutical, catalyst, and cosmetics industries.[1] Following her doctoral defense, Washington Greene went on to become the first African American female employed in a scientific research role at the Dow Chemical Company, where her innovations were awarded three patents.

Washington Greene was born on March 20, 1935, to George Washington and Kian Criss, in Palestine, Texas, where she attended Our Lady of Mercy Elementary School and James E. Guinn Junior High School. She later attended I.M. Terrell High School in Fort Worth, Texas.[2] All were segregated public schools. After high school, with the encouragement of a teacher, Washington Greene enrolled at the Tuskegee Institute (now known as Tuskegee University) in Alabama to pursue a B.S. in chemistry, which she received in 1955.

In the aftermath of *Brown v. Board of Education*, Washington Greene believed that she had the opportunity to continue her education and applied for graduate study at both Wayne State University and the Massachusetts Institute of Technology. She was accepted into both graduate programs and selected Wayne State, which was nationally known for its premier research department in chemical sciences.[3] Wayne State also provided full financial support, supplemented with research funding from the Office of Naval Research. As a doctoral student, she taught undergraduate chemistry at the university while balancing duties at home as a wife and mother of three children. Washington Greene broke barriers culturally and scientifically when she earned her Ph.D. from Wayne State University in 1965.[4] Her successful defense of her doctoral thesis in physical chemistry, titled "Determination of Particle Size Distributions in Emulsions by Light Scattering," put her in a select club of a handful of African American women with doctoral degrees in chemistry.[4] Light scattering is now an established technique for determining the diameter of particles in colloidal suspensions and solutions. Her doctoral research set the foundation for establishing the necessary techniques and analyses to accurately measure colloidal particle size across a variety of applications including the development of drugs and catalysts.[5] In latex colloidal paints, small particles result in water-resistant, clear coatings that more easily penetrate the coated surface.

Washington Greene continued her career at Dow Chemical Company in Midland, Michigan, where she was hired as a research chemist in its Edgar C. Britton Research Laboratory. She published vital research in peer-reviewed journals that established her expertise in polymer materials including latex, a water emulsion of synthetic rubber or plastic that is used in paints, other coatings, and adhesives. She was tasked to research colloid and latex chemistry, including interactions between latex and paper.[6] Moreover, she served as a consultant on polymer materials challenges in Dow's Saran Research Laboratory. Additionally, the Styrene Butadiene Latex Group often utilized her expertise.[6]

Consistently exceeding expectations, Washington Greene was promoted to senior research chemist in 1970. She published several papers evaluating various properties that result in the adsorption of latex particles in an aqueous solution; a process necessary for the creation and coloring of latex paint.[7] She also made important progress in the development of methodologies for determining surface tension of liquids and solutions.[8] Subsequently, in 1973 she joined the Designed Polymers Research Division. Due to her outstanding technical leadership and notable contributions, Washington Greene was promoted to senior research specialist. She presented novel research findings explaining the interaction between styrene/butadiene latexes and cellulose fibers at professional research meetings including the Fourth International Conference on Surface and Colloid Science at Hebrew University, Jerusalem, Israel, on July 7, 1981.[9]

Among the many accomplishments throughout her career, Washington Greene was issued several patents. In 1985, her patent, "Stable Latexes Containing Phosphorus Surface Groups," described a method of preparing a paper coating composition by adding 2 to 30% of a modified latex containing phosphorus surface groups.[10] In 1986, she received a follow-on patent, "Composite Sheet Prepared with Stable Latexes Containing Phosphorus Surface Groups," which employed emulsion polymerization techniques for preparing modified latex.[11] The patent, "Latex Based Adhesive Prepared by Emulsion Polymerization," was issued to Washington Greene, and centered on the invention of a latex-based, pressure-sensitive adhesive for coating conventional substrates to form an adhesive tape.[12]

Washington Greene's persistence in improving the fundamental properties of latex has been pivotal to the polymeric materials science community. Her career success, however, did not come without struggle. At Dow, Washington Greene faced challenges that were directly tied to discrimination as a person of color. "She went up the [company] ranks, but she was frustrated towards the end of her career," remarked her daughter, Willetta Greene-Johnson, a theoretical physicist.[1] This aggravation stemmed from her duteous training of employees with lesser credentials that were being promoted over her.[13] After making significant contributions to the industry for a quarter century, she retired in 1990.

"Washington Greene's persistence in improving the fundamental properties of latex has been pivotal to the polymeric materials science community."

Composite image of Dow Chemical microscope (left; photo coutesy of Science History Institute) and depiction of chemical analysis laboratory at Dow Chemical Company (background; photo courtesy of Science History Institute).

Washington Greene was dedicated to community empowerment. Her passion for service and resilient leadership led her to become a founding member of the Midland, Michigan, Alumnae Chapter of Delta Sigma Theta Sorority Inc., a national public service group promoting the work of African American women.[1] She was also elected to Sigma Xi, the Scientific Research Honor Society.[8]

Washington Greene dedicated her entire career to scientific research. In doing so, she lit the path for African American women in the field. She is a pioneer of polymer materials who overcame countless challenges of discrimination. Her professional accomplishments in the corporate and academic worlds were impressive and impactful by any measure. She reached one of the highest technical levels at a company regarded as a global leader in materials science. After decades of contributions to science, she passed away in Midland on June 16, 1995.[9] Her legacy continues through the valuable citations of her research, her impact on the materials and chemistry communities, and her status as a role model for the many who have and will follow after her example.

"...she lit the path for African American women in the field."

Clinique Brundidge is a lead materials scientist & engineer at the Naval Surface Warfare Division, Corona Division. A TMS member since 2007, she is a member of the TMS Diversity, Equity, and Inclusion Committee and is a 2022 TMS Young Leaders Professional Development Award recipient.

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JOM: The Magazine, Vol. 74, No. 2, 2022
https://doi.org/10.1007/s11837-021-05129-4

Table of Contents

BOLDLY RECONNECTING AND LOOKING TO THE FUTURE

Megan Enright and Ann Ritchie

Together again, TMS partnered with The American Ceramic Society (ACerS) and the Association for Iron and Steel Technology (AIST) to host the Materials Science & Technology (MS&T) Technical Meeting and Exhibition on October 17–20, 2021, in Columbus, Ohio. For many, it was the first opportunity to meet in person since the COVID-19 pandemic pivoted conferences to virtual platforms.

The nineteenth installment of MS&T offered an extensive technical program that included 75 symposia in 13 technical tracks. Technical programming took place primarily at the Greater Columbus Convention Center, while TMS social functions met at the Hyatt Regency Columbus. More than 1,500 people registered for the event, with 1,035 attending in person and 472 watching on demand. The exhibit hall and meeting rooms conveyed a celebratory vibe as scientists, engineers, researchers, exhibitors, and students reemerged and reconnected.

PLENARY SESSION

The plenary session took place on Tuesday morning and honored **Tresa Pollock**, the TMS 2021 Institute of Metals/Robert Franklin Mehl Awardee. Ellen Cerreta, 2021 TMS President, introduced Pollock, who is the Alcoa Professor of Materials at the University of California, Santa Barbara. Pollock's talk, "New Superalloys in the Co-Ni Design Space for 3D Printing," delved into the high-temperature history of nickel-based superalloys and cobalt superalloys for uses such as rocket engines, aircraft engines, and gas turbines for power generation and then presented the opportunities and challenges of nickel-cobalt superalloys. "Exploration of space has benefited a lot from new tools for alloy design. In the process of using these tools, I think we came to the conclusion that additive manufacturing was a good place for these materials to go," Pollock said.

Tresa Pollock with the TMS Institute of Metals/Robert Franklin Mehl Award.

Pollock discussed laser powder bed and electron beam additive manufacturing as promising options for metallic materials. She noted that in the past five years, more than 1,300 companies formed worldwide with a focus on additive manufacturing. "I think everyone here knows about the excitement behind additive manufacturing and of the things it may enable in terms of design innovation, part reduction in complex platforms, and payoffs of sustainability in terms of energy and materials savings. While it is difficult, it's kind of like welding a structure. It seems like the tradeoffs need to be looked at," Pollock said.

The plenary session also featured **Anil Sachdev**, principal technical fellow and lab group manager at GM Global Research and Development, delivering the AIST Adolf Martens Memorial Steel Lecture, and **Clive Randall**, director of the Materials Research Institute at The Pennsylvania State University, giving the ACerS Edward Orton Jr. Memorial Lecture. Sachdev's "Iron – The Ubiquitous Element," told the story of iron's past and celebrated its potential for continued development in the future, while Randall's "Turning Down the Heat in Sintering to Enable the Unification of all Materials," explored the ceramic sintering process with a focus on the challenges and opportunities of cold sintering, including its role in a sustainable economy.

TMS YOUNG PROFESSIONAL TUTORIAL LUNCHEON AND LECTURE

Elizabeth Opila, University of Virginia, assures her audience at the TMS Young Professional Tutorial Luncheon and Lecture that having a complete map of their career path is not necessary for finding success.

Early career professionals and students were treated to a special luncheon on Tuesday spotlighting the career of Elizabeth Opila, University of Virginia. Opila is the Rolls Royce Commonwealth Professor of Engineering, professor of materials science and engineering, and director of the Rolls Royce University Technology center on Advanced Material Systems.

It's okay not to have a complete career plan, according to Opila, who gradually developed an impressive career one step at a time. She advised the audience on the secrets to her success in her talk, "Reflections on a Random Walk Approach to a Career in Materials Science."

Opila spent 19 years at NASA Glenn Research Center that included responsibilities such as examining the Challenger disaster, publishing her research, and being a project manager. Here, she discovered she had a knack for mentoring interns. "I found their curiosity in the lab really exciting," Opila said. Between her research, mentoring, and publishing activities, her experiences at NASA smoothed the way for her next "big adventure in academia" as a faculty member at the University of Virginia. At the university, she grew to love teaching but also was pleased to discover she could further her research interests, particularly through a sabbatical opportunity at the Max Planck Institute for Solid State Research.

She finds career success by making good decisions along the way as opposed to having a master plan. "This random walk [through my career] was not completely random because opportunities bias where you go," Opila said.

ADVANTAGE AWARDEES

Rafael Rodriguez de Vecchis, University of Pittsburgh, with the 2021 TMS International Symposium on Superalloys Scholarship.

The third day of MS&T21 offered the culmination of the student events with the Material Advantage Student Awards Ceremony.

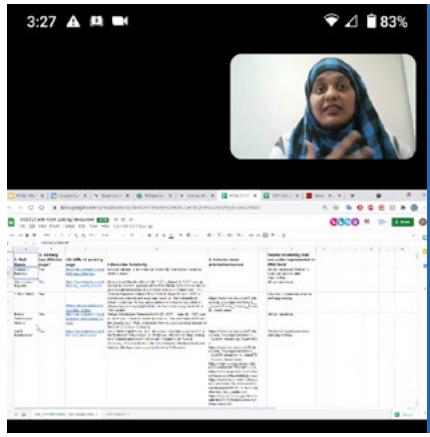
TMS was honored to present Rafael Rodriguez de Vecchis, University of Pittsburgh, and Preston Nguyen, University of Pittsburgh, with the TMS International Symposium on Superalloys Scholarship, funded through the TMS Foundation and issued under the generosity of the TMS International Symposium on Superalloys Committee. These scholarships are available to undergraduate and graduate students majoring in metallurgical and/or materials science and engineering with an emphasis on all aspects of superalloys. Two scholarships are awarded annually, each valued at $2,000.

Preston Nguyen, University of Pittsburgh, with the 2021 TMS International Symposium on Superalloys Scholarship.

Also honored at this ceremony was the awardee for Most Outstanding Material Advantage Chapter, the University of North Texas. This award is accompanied by a certificate and $750 prize. Congratulations to all the award recipients!

WIKIPEDIA EDIT-A-THON

The MS&T Wikipedia Edit-a-Thon for Diversity in Materials Science and Engineering helped to give recognition where it was past due. Few realize that only 18.6% of English-language biographies on Wikipedia are about women. To address this, the 500 Women Scientists organization, the programming partner for this event, pioneered the concept of Wikipedia Edit-a-Thons specifically focused on advancing diversity, equity, and inclusion in STEM.



Farah Qaiser, Evidence for Democracy, presented an introduction and tutorial for Wikipedia Edit-A-Thon attendees.

MS&T participants met virtually to learn how to create, edit, and translate Wikipedia pages on researchers and scientists from underrepresented minorities. Presenter Farah Qaiser, director of research and policy at Evidence for Democracy, led the session.

Qaiser explained that one of the challenges to minorities being represented on Wikipedia is meeting the notability criteria that Wikipedia has established for the creation of new entries. Individuals meet notability criteria through publications and honors; however, women and minorities have yet to gain equal representation in recognition through media coverage and major awards. Through combined and concentrated efforts, such as edit-a-thons, participants are increasing the visibility of those accomplishments. It makes a difference by inspiring the next generation.

"Women and minorities are more likely to pursue STEM careers if they see more people who look like them in role model positions," Qaiser said.

Co-organized by AcerS, AIST, and TMS, the event served as the inaugural Annual MS&T Diversity, Equity & Inclusion Engagement Event.

MIXERS AND RECEPTIONS

The MS&T Women in Materials Science Reception gathered students, professionals, and other conference attendees on Sunday to network and extend their support for underrepresented groups in the materials science and engineering field.

A representative from each of the partner societies shared some opening words on the importance of being inclusive organizations that honor and encourage all to participate in the field. Tom Battle, 2020 TMS President, highlighted this in his opening remarks, "As all of you in this room know, advancing diversity, equity, and inclusion is not easy, but I can tell you from experience, that by working together, we can make a difference…TMS has made being a

Tom Battle, 2020 TMS President, provides opening remarks on behalf of Ellen Cerreta, 2021 TMS President, and the TMS Board of Directors at the Women in Materials Science Reception.

highly inclusive society its number one strategic goal for more than a decade and, over that time, has been very intentional in trying to increase engagement of underrepresented groups in our membership."

Refreshments and lively conversation followed the opening remarks. With attendees excited to be back in person, they shared career advice, experiences, and stories. Battle summed up the atmosphere of the event: "As the president who presided during the darkest days of the pandemic, I am delighted to be able to gather in-person with you today."

Attendees engage in conversation, networking, and refreshments at the Women in Materials Science Reception.

In-person networking continued at several MS&T social events, ranging from interest-based gatherings, such as the TMS Pride Mixer and Student Networking Mixer, both on Sunday, to the large, all-conference Partners' Welcome Reception on Monday and Exhibitor Networking Reception on Tuesday.

TMS MEMBERS HONORED AT MS&T21

TMS applauds the following members who received recognition at MS&T21 for outstanding contributions to their fields from the American Ceramic Society (ACerS) at its Annual Honor and Awards Banquet and Reception, held on Monday, October 18, as a part of the ACerS 123rd Annual Meeting.

2021 Class of Fellows

Arvind Agarwal, *Florida International University*

Cato Laurencin, *University of Connecticut Health Center*

Federico Rosei, *Institut National de la Recherche Scientifique (INRS)*

Richard M. Fulrath Awards, American Academic

Surojit Gupta, *University of North Dakota*

ACerS/Education and Professional Development Council (EPDC) Arthur L. Friedberg Ceramic Engineering Tutorial and Lecture

Elizabeth Opila, *University of Virginia*

MS&T21 attendees mingled with colleagues and enjoyed hors d'oeuvres at the Partners' Welcome Reception.

MARK YOUR CALENDARS FOR MS&T22

MS&T21 was an event for the record books, not only for the honored speakers, advanced research, and student achievements, but also for the high sense of enthusiasm shared by the participants, simply for the opportunity to get together. Set to build upon this sense of renewal, MS&T22 will take place October 9–13, 2022 in Pittsburgh, Pennsylvania.

The call for abstracts is now open, with an extensive technical program featuring 80 symposia in 15 technical tracks, including a new Education track, for the 20th installment of MS&T. **Abstracts are due March 15, 2022.** Visit www.matscitech.org/MST22 for program details and to submit your work today.

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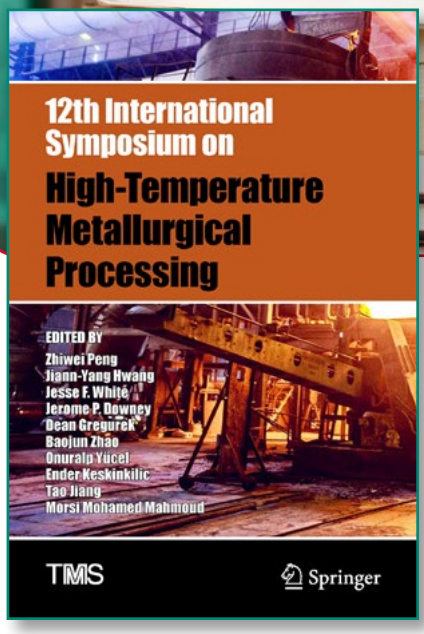
Explore the TMS2022 Proceedings Volumes

Megan Enright

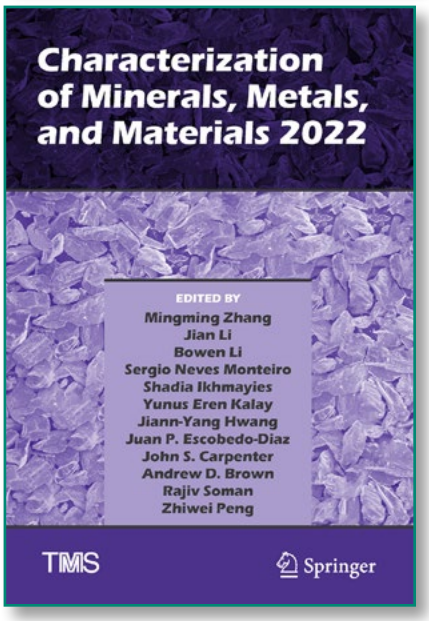
Registrants of the TMS 2022 Annual Meeting & Exhibition (TMS2022) will have free, online access to the meeting's proceedings publications as a benefit of attending. For those who are unable to register for TMS2022, the proceedings volumes, as well as individual papers, can be purchased through the TMS Bookstore portal at www.tms.org/Bookstore. All 10 publications will be available by the start of the meeting.

TMS members receive a 40% discount on TMS proceedings publications, and a 20% discount on TMS non-proceedings titles published with Springer. Visit www.tms.org/Bookstore, log in to see the discount, and enter the appropriate code when checking out on the Springer website. Read on to learn more about each of the TMS2022 titles.



12th International Symposium on High-Temperature Metallurgical Processing

This collection includes the analysis, development, and operation of high-temperature processes that involve the extraction and processing of material resources, production, and treatment of metals, alloys, and ceramic materials. Contributions describe innovative methods for achieving property enhancement, impurity segregation and removal, byproduct recovery, waste minimization, energy efficiency, and utilization of complex ores. Also included are various technical, economic, and environmental issues associated with commercial-scale high-temperature processing methods.

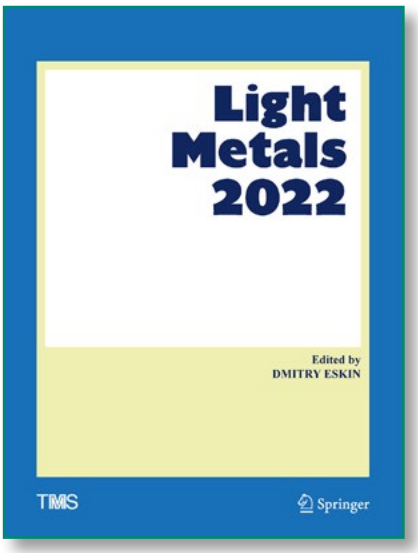


Characterization of Minerals, Metals, and Materials 2022

This collection focuses on the advancements of characterization of minerals, metals, and materials and the applications of characterization results on the processing of these materials. Advanced characterization methods, techniques, and new instruments are emphasized. Areas of interest include, but are not limited to: novel methods and techniques for characterizing materials across a spectrum of systems and processes; characterization of mechanical, thermal, electrical, optical, dielectric, magnetic, physical, and other properties of materials; characterization of structural, morphological, and topographical natures of materials at micro- and nanoscales; characterization of extraction and processing including process development and analysis; advances in instrument developments for microstructure analysis and performance evaluation of materials, such as computer tomography (CT), X-ray and neutron diffraction, electron microscopy (SEM, FIB, TEM), and spectroscopy (EDS, WDS, EBSD) techniques; and 2D and 3D modelling for materials characterization.

Furnace Tapping 2022

No pyrometallurgical smelter can operate without some form of tapping system. It is the one thing all smelters have in common. This collection discusses this meeting point of the science, technology, and skill involved in this process. The tap-hole design process includes a set of design criteria, which need to be revised as the results of laboratory, computational fluid dynamics (CFD), and time-and-motion studies become available. The tap-hole life cycle is considered in this volume, with authors addressing the requirements for installation and operability as well as for maintenance. Matters such as online monitoring of the tap-hole wear, handling of liquid products, and extraction of fumes are all discussed.

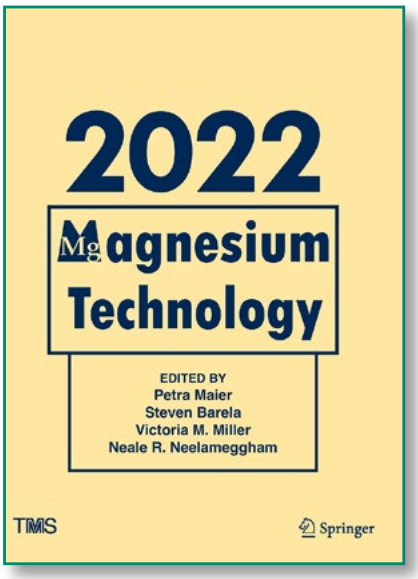


Light Metals 2022

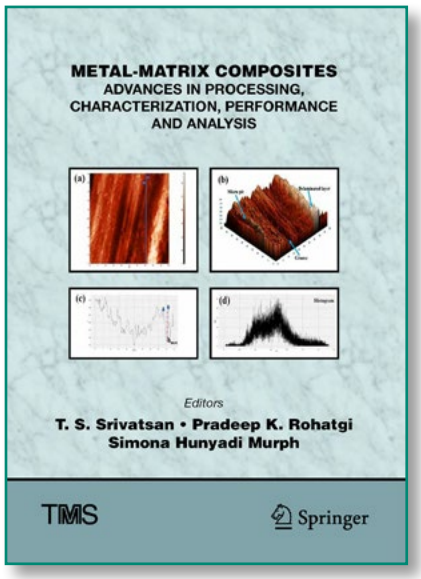
The annual *Light Metals* volume has become the definitive reference in the field of aluminum production and related light metal technologies. The 2022 collection includes contributions from the following symposia: Alumina and Bauxite; Aluminum Alloys, Processing, and Characterization; Aluminum Reduction Technology; Aluminum Reduction Technology Joint Session with REWAS: Decarbonizing the Metals Industry; Cast Shop Technology; Electrode Technology for Aluminum Production; Primary Aluminum Industry – Energy and Emission Reductions: An LMD Symposium in Honor of Halvor Kvande; and Recycling and Sustainability in Cast Shop Technology: Joint Session with REWAS 2022.

Magnesium Technology 2022

Magnesium Technology 2022 is a definitive reference that covers a broad spectrum of current topics, including novel extraction techniques; primary production; alloys and their production; integrated computational materials engineering; thermodynamics and kinetics; plasticity mechanisms; cast products and processing; wrought products and processing; forming, joining, and machining; corrosion and surface finishing; fatigue and fracture; dynamic response; structural applications; degradation and biomedical applications; emerging applications; additive manufacturing of powders; and recycling, ecological issues, and life cycle analysis.



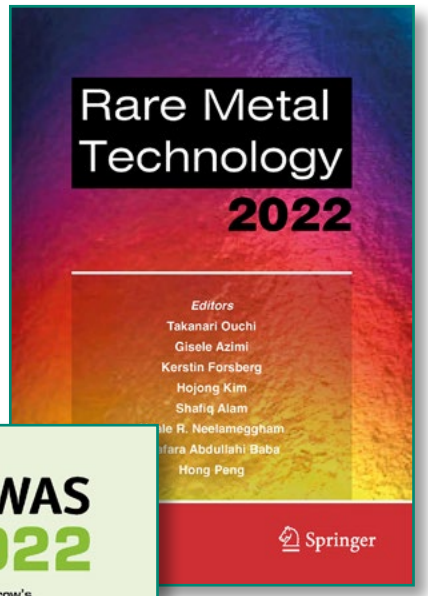
Metal-Matrix Composites: Advances in Processing, Characterization, Performance and Analysis



This collection brings together engineers, scientists, scholars, and entrepreneurs to present their novel and innovative contributions in the domain specific to metal-matrix composites and on aspects specific to processing, characterization, mechanical behavior, measurements, failure behavior, and kinetics governing microstructural influences on failure by fracture. Topics include but are not limited to: metals and metal-matrix composites; nano-metal based composites; and intermetallic-based composites. Contributions in the above topics connect to applications in industry-relevant areas: automotive; nuclear and clean energy; aerospace; failure analysis; biomedical and healthcare; and heavy equipment, machinery, and goods.

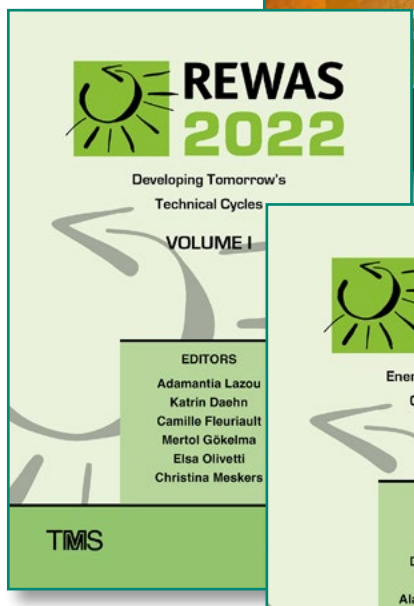
Rare Metal Technology 2022

This collection presents papers from a symposium on extraction of rare metals from primary and secondary materials and residues as well as rare extraction processing techniques used in metal production. Authors cover the extraction of less common or minor metals. Contributions also discuss rare metals of low-tonnage sales compared to high-tonnage metals. Authors also cover biometallurgy, hydrometallurgy, and electrometallurgy while novel high-temperature processes such as microwave heating, solar-thermal reaction synthesis, and cold crucible synthesis of rare metals are addressed. Also included in this collection is the design of extraction equipment used in these processes from suppliers as well as laboratory and pilot plant studies.



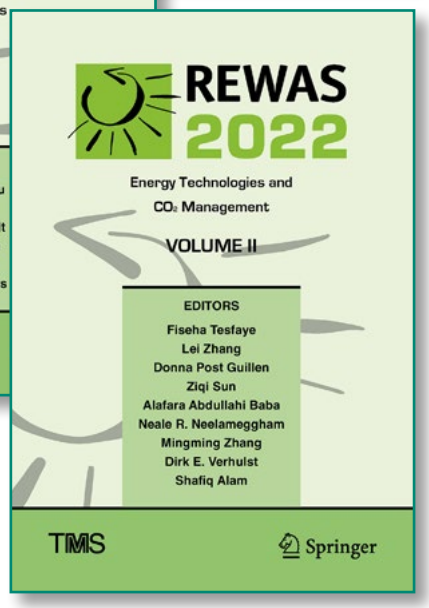
REWAS 2022: Developing Tomorrow's Technical Cycles (Volume I)

The papers in this collection explore the latest technical and societal developments enabling sustainability within our global economy with an emphasis on recycling and waste management. The 2022 collection includes contributions from the following symposia: Coupling Metallurgy and Sustainability: An EPD Symposium in Honor of Diran Apelian; Recovering the Unrecoverable; Sustainable Production and Development Perspectives; Automation and Digitalization for Advanced Manufacturing; and Decarbonizing the Materials Industry.



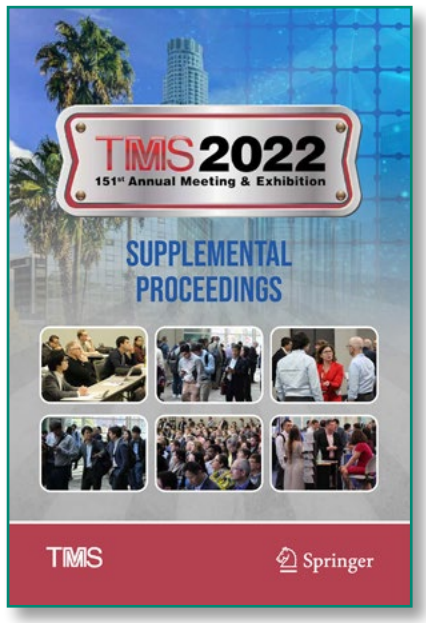
REWAS 2022: Energy Technologies and CO_2 Management (Volume II)

This collection, with authors representing industry, government, and academia, focuses on energy efficient technologies including innovative ore beneficiation, smelting technologies, recycling and waste heat recovery, and emerging novel energy technologies. The symposium also covers various technological aspects of sustainable energy ecosystems, processes that improve energy efficiency and reduce thermal emissions. Topics include renewable energy and combustion technologies; energy efficiency, decarbonization, and CO_2 management; and thermal management and hydrogen technology.



TMS 2022 151st Annual Meeting & Exhibition Supplemental Proceedings

This collection features papers presented at the 151st Annual Meeting & Exhibition of The Minerals, Metals & Materials Society. The contributions represent 71 symposia from the meeting.



JOM: The Magazine, Vol. 74, No. 2, 2022
https://doi.org/10.1007/s11837-021-05131-w

In Case You Missed It:

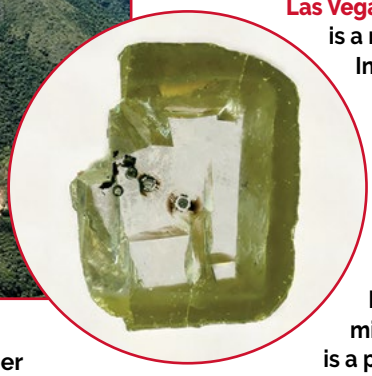
BUSINESS NEWS FROM THE FIELD

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* Managing Editor, at kcalva@tms.org for consideration.

Antioquia, Colombia: (Above Photo) Top Chinese gold producer, Zijin Mining, plans to produce copper and zinc in addition to gold and silver at its Buritica gold mine in Antioquia, Colombia. The goal is to boost output to 4,000 tonnes per day (tpd) from the current 3,000 to 3,300 tpd and add a flotation circuit to increase the suite of metals produced. The expansion will allow Buritica, one of the country's five large-scale mines, to produce 240,000 ounces a year of gold, 600 tonnes per year (tpy) of copper, and 5,000 tpy of zinc. Zijin Mining acquired the mine after buying Canada's Continental Gold for $1 billion in late 2019. (Photo courtesy Zijin Continental Gold.)



Las Vegas, Nevada, USA: (Photo Left) Davemaoite is a new mineral recognized by the International Mineralogical Association. University of Nevada geochemists discovered it inside a diamond from Botswana and traced the mineral's origin to at least 410 miles underground in the earth's lower mantle between the core and the crust. The discovery marks the first time that lower mantle minerals have been observed in nature. The mineral's namesake, Ho-kwang "Dave" Mao, is a pioneer in high-pressure geochemistry and geophysics. (Photo Credit: Aaron Celestian, Natural History Museum of Los Angeles County)

EOS, Metalpine to Jointly Develop New Metal Powders

Krailling, Germany: EOS GmbH acquired a stake in Metalpine GmbH, a metal powder manufacturer based in Graz, Austria, with the aim of jointly developing innovative and sustainable metal powders. Metalpine creates new types of powder with optimum efficiency, and its new production center produces highly spherical metal powders from a wide range of metals and metal alloys, including copper, steel, nickel-based alloys, titanium, molybdenum, and tungsten. By pairing Metalpine's atomization technology with the material, process, and system development competence of EOS, the partners will be positioned to make sustainable and economically efficient powder products for additive manufacturing.

Partners Produce Aluminum-Scandium Alloy

Moscow, Russia: United Company Rusal, a global aluminum producer, together with KUMZ, successfully launched the production of various rolled and pressed semi-finished products from an aluminum-magnesium-scandium alloy of grade 1581. KUMZ organized the commercial production of plates and sheets from ingots, produced by the Krasnoyarsk aluminum smelter in accordance with a specially developed rolling technology. The semis are in demand from the Russian transport-engineering sector, which develops and produces products for the railway and shipbuilding industries. The product offers a significantly reduced cost, making it competitive against traditional aluminum solutions.

Shapeways, Desktop Metal Expand AM Services

New York, New York, USA: Shapeways Inc. partnered with Desktop Metal Inc. to improve access to additive manufacturing (AM) services to industrial customers. Shapeways is expanding Desktop Metal's system capacity and capabilities by providing customers access to these solutions at Shapeways' ISO-9001 manufacturing facilities. In addition, Desktop Metal plans to leverage Shapeways' manufacturing capabilities and purpose-built software platform, Otto, to provide its customers with instant access to fully digitized, end-to-end workflows. The solutions will roll out in 2022 and will offer industrial customers a means to leverage AM capacity on demand.

Zinc Mine Yields Copper, Too

Vancouver, Canada: Fireweed Zinc Ltd. reported significant copper mineralization encountered in the Boundary Zone at Macmillan Pass, bringing a new metal into play at the zinc project in eastern Yukon. The Macmillan Pass property covers a 34-mile trend of potential zinc-lead-silver, and now copper, mineralization. First drilled in 2019, the Boundary Zone has since been found to have three distinct zones of zinc, lead, and silver, including a newly discovered zone of high-grade laminated stratiform mineralization similar in style to two other deposits on the property just nine miles to the east.

JOM: The Magazine, Vol. 74, No. 2, 2022
https://doi.org/10.1007/s11837-021-05132-9

TMS MEETING HEADLINES

JOM THE MAGAZINE

Meeting dates and locations are current as of December 20, 2021.
For the most recent updates on TMS-sponsored events, visit **www.tms.org/Meetings**.

TMS 2022 Annual Meeting & Exhibition (TMS2022)

February 27–March 3, 2022

Anaheim, California, USA

Join us for TMS2022 and explore more than 90 symposia planned by all five TMS technical divisions on a broad range of topics. Your registration also includes access to three co-located meetings: the fourth Summit on Diversity in the Minerals, Metals, and Materials Professions (DMMM4), Furnace Tapping 2022, and the 7th installment of the REWAS conference series.

www.tms.org/TMS2022

6th International Congress on 3D Materials Science (3DMS 2022)

June 26–29, 2022

Washington, D.C., USA

Discount Registration Deadline: May 13, 2022

Building on the progress gained at the 2021 virtual meeting, 3DMS 2022 will provide an intimate environment for rich discussions and interactions among key researchers in the world to not only assess the state-of-the-art within the various elements of 3D materials science, but also to roadmap critical areas of future research.

www.tms.org/3DMS2022

Additive Manufacturing Benchmarks (AM-Bench) 2022

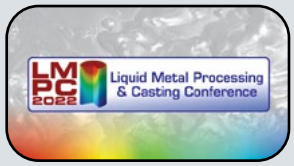
August 15–18, 2022

Bethesda, Maryland, USA

Housing Deadline: July 22, 2022

The AM-Bench conference series provides controlled benchmark measurements that enable modelers to test their simulations against rigorous additive manufacturing benchmark test data. AM-Bench 2022 convenes modelers and experimentalists to share these test results and discuss successes and challenges.

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 will convene experts from both industry and academia to discuss the latest advances in primary and secondary melt processing including vacuum induction melting (VIM), vacuum arc remelting (VAR), electroslag refining (ESR), and electron beam cold hearth remelting (EBCHR).

www.tms.org/LMPC2022

Other Meetings of Note

6th World Congress on Integrated Computational Materials Engineering (ICME 2022)

April 24–28, 2022

Lake Tahoe, Nevada, USA

www.tms.org/ICME2022

Congress on Safety in Engineering and Industry 2022

August 15–17, 2022

Fort Worth, Texas, USA

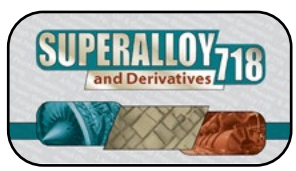
www.SafetyCongress.org

Materials Science & Technology 2022 (MS&T22)

October 9–13, 2022

Pittsburgh, Pennsylvania, USA

www.matscitech.org/MST22



Superalloy 718 and Derivatives 2023

May 14–17, 2023

Pittsburgh, Pennsylvania, USA

www.tms.org/Superalloy718-2023

Co-Sponsored Meetings

Offshore Technology Conference (OTC) 2022

May 2–5, 2022

Houston, Texas, USA

ALTA 2022 Nickel-Cobalt-Copper, Uranium-REE, Gold-PM, In Situ Recovery, Lithium & Battery Technology Conference & Exhibition

May 20–27, 2022

Perth, Australia

8th International Conference on Solid - Solid Phase Transformations in Inorganic Materials (PTM2022)

June 27–July 1, 2022

Xi'an, China

The 12th International Conference and Workshop on Numerical Simulation of 3D Sheet Metal Forming Processes (NUMISHEET 2022)

July 10–14, 2022

Toronto, Ontario, Canada

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

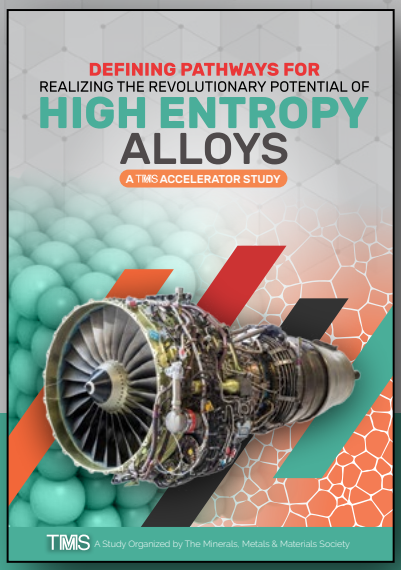
TMS FURNACE TAPPING 2022

REWAS 2022 Developing Tomorrow's Technical Cycles

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

Visit the TMS2022 website to register today:

www.tms.org/TMS2022



DEFINING PATHWAYS FOR REALIZING THE REVOLUTIONARY POTENTIAL OF HIGH ENTROPY ALLOYS

A TMS ACCELERATOR STUDY

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Scientific exploration in the field of high entropy alloys (HEAs) has recently exploded. In 2021, TMS led an expert study team on a 15-month effort to identify priority areas within this exciting area of research.

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Go to **www.tms.org/HEApathways** to download the free report.

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A study organized by The Minerals, Metals & Materials Society (TMS) on behalf of the Defense Advanced Research Projects Agency (DARPA) and Air Force Research Laboratory (AFRL).

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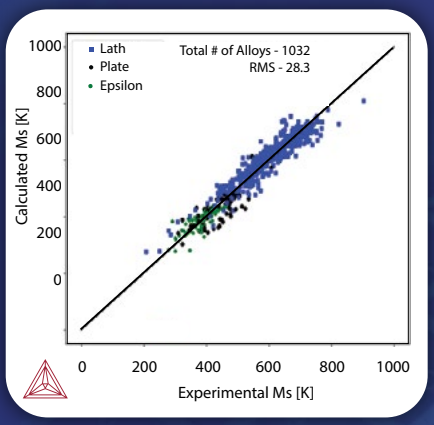
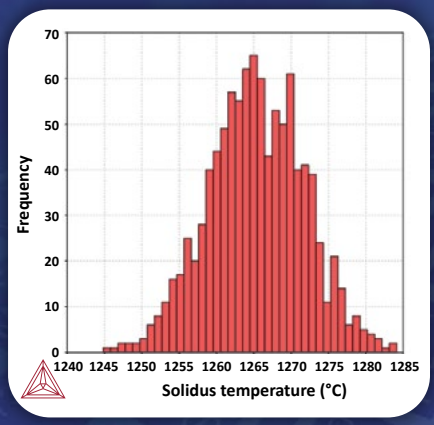


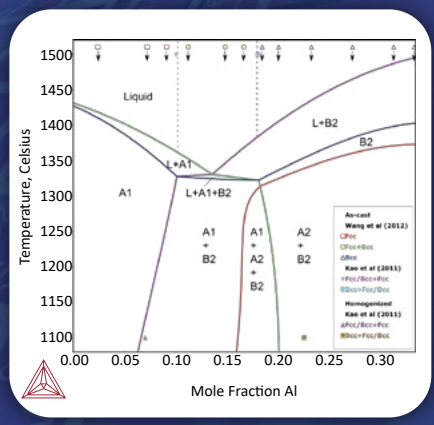
Comparison of calculated and experimental Ms temperatures for a wide range of steels

Nickel



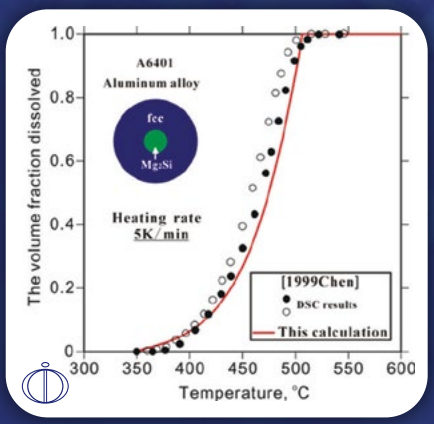
Variation in solidus temperature over 1000 compositions within alloy 718 specification

High Entropy Alloys



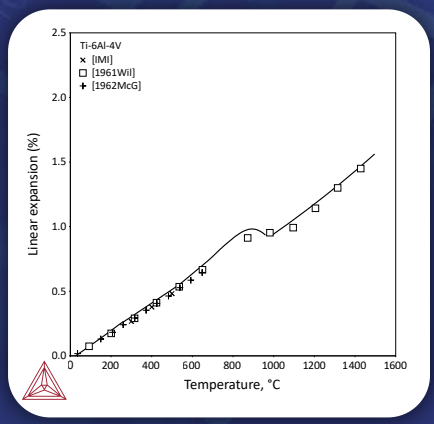
Calculated phase diagram along the composition line of CoCrFeNi-Al

Al Alloys



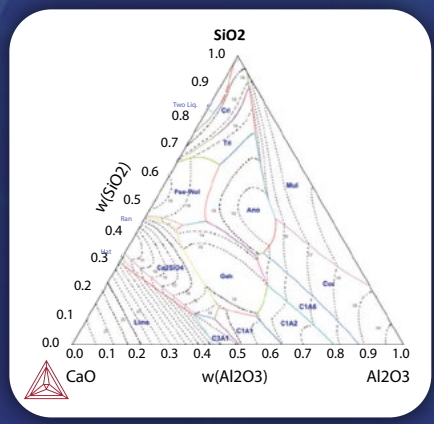
Dissolution of Mg2Si precipitate in Alloy A6401

Ti and TiAl Alloys



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

Oxides



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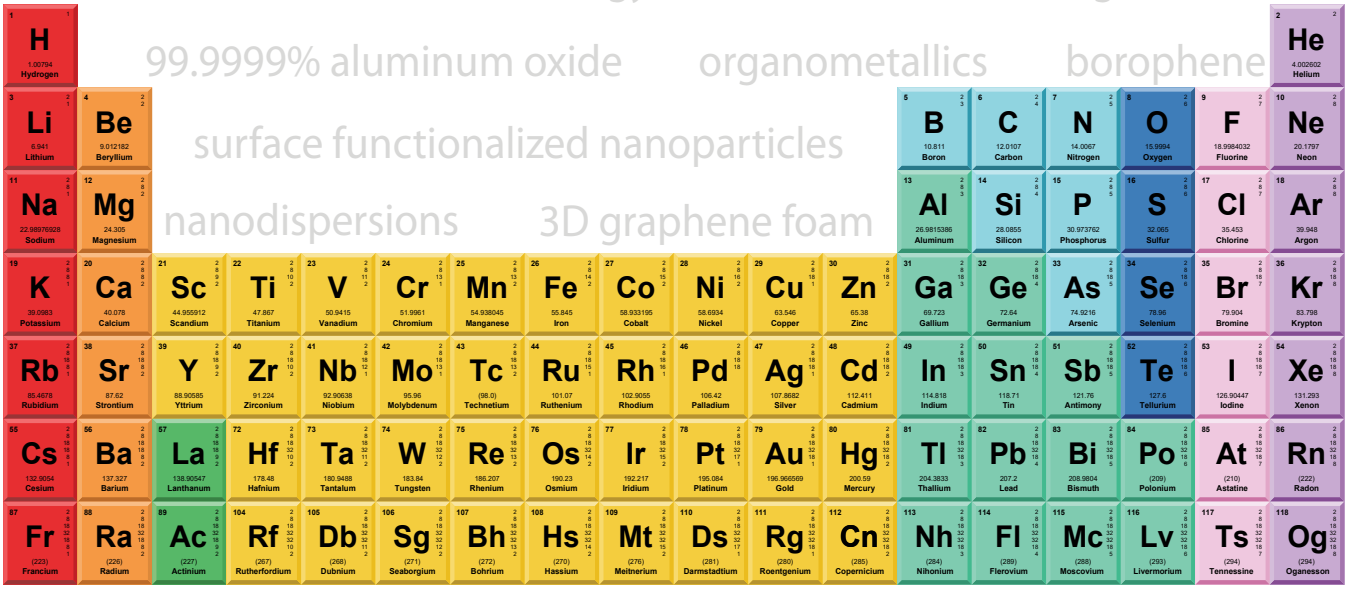

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