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emerging ceramics & glass technology

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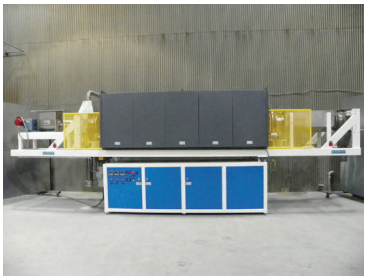

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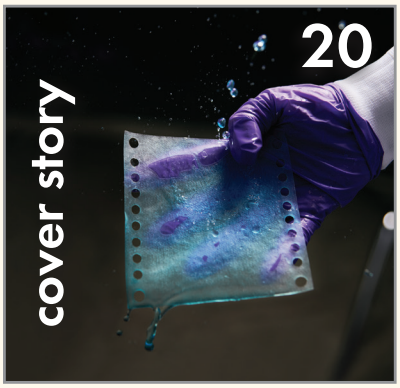
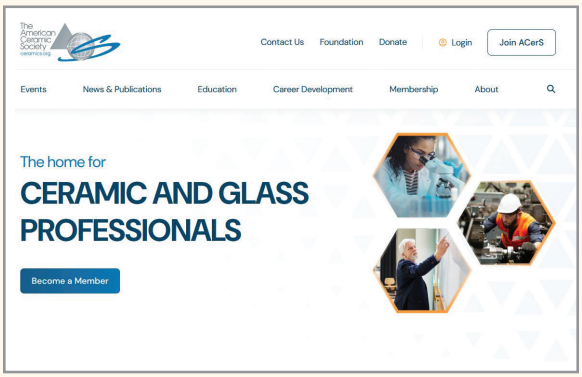
feature articles





Now launched: A new look for ceramics.org

Visitors to the ACerS website will find a newly refreshed and updated site with streamlined navigation capabilities and improved search functionalities. Check out the new site by visiting https://ceramics.org.

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http://bit.ly/acerstwitter http://bit.ly/acerslink http://bit.ly/acersfb

As seen on *Ceramic Tech Today*...

Credit: Incredible Dooars, YouTube

Protecting elephants and trains through fiber-optic sensing

Death from train collisions is the second-highest cause of unnatural elephant deaths in India. Austria-based information provider Sensonic contracted with Indian Railways to deploy a fiber-optic-based elephant detection and alert system along the railway's East Coast network.

Read more at www.ceramics.org/elephant-protection

Also see our ACerS journals...

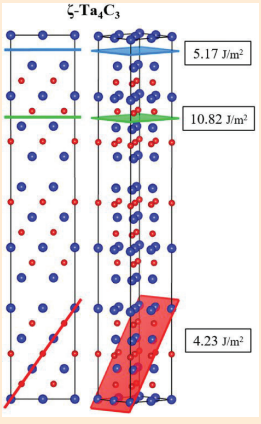
These articles are available online now and will appear in the December 2024 issue of *Journal of the American Ceramic Society*, which focuses on computational studies in ceramics and glass.

Exploring fracture anisotropy in tantalum carbide compounds: A density functional theory approach
By S. Hossain, G. B. Thompson, and C. R. Weinberger
Journal of the American Ceramic Society

Hysteresis constitutive model of C/SiC composites considering probabilistic matrix fragmentations
By L. Li
Journal of the American Ceramic Society

Applications of machine-learning interatomic potentials for modeling ceramics, glass, and electrolytes: A review
By S. Urata, M. Bertani, and A. Pedone
Journal of the American Ceramic Society

Characterizing medium-range order structure of binary silicate glasses using ring analysis and persistent homology
By A. F. Firooz, R. Christensen, C. A. N. Biscio, and M. M. Smedskjaer
Journal of the American Ceramic Society



Credit: S. Hossain et al., *JACerS*

Read more at www.ceramics.org/journals

American Ceramic Society Bulletin is the membership magazine of The American Ceramic Society. It covers news and activities of the Society and its members and provides the most current information concerning all aspects of ceramic technology, including R&D, manufacturing, engineering, and marketing. *American Ceramic Society Bulletin* is published monthly, except for February, July, and November. Subscription included with The American Ceramic Society membership. Nonmember subscription rates can be found online at www.ceramics.org or by contacting customer service at customerservice@ceramics.org.

POSTMASTER: Please send address changes to American Ceramic Society Bulletin, 550 Polaris Parkway, Suite 510, Westerville, OH 43082-7045. Periodical postage paid at Westerville, Ohio, and additional mailing offices. Allow six weeks for address changes.

ACSBA7, Vol. 103, No. 8, pp. 1–40. All feature articles are covered in Current Contents.

Circular Supply Chain Coalition establishes e-waste recycling networks in local communities

While a lot of time is spent celebrating new technological advances, the question of what to do with these devices at the end of their life is generally less frequently discussed. But over the past decade, the topic of electronic waste, or e-waste, has become increasingly difficult to ignore.

In 2022, a record 62 million metric tons of e-waste were produced, up 82% from 2010. But even as more e-waste is being produced, less than one quarter (22.3%) of e-waste mass in 2022 was documented as having been properly collected and recycled. Without intervention, the gap between e-waste generation and recycling is expected to grow even larger by 2030, with generation growing to 82 million metric tons and recycling dropping to only 20%.

The above statistics comes from the 2024 Global E-waste Monitor report. This report is published every few years as a partnership between the United Nation's Sustainable Cycles program and the International Telecommunication Union, the United Nation's specialized agency for digital technology.

While there are obviously environmental risks of e-waste, there is also an untapped economic component to this complex waste stream. The 2024 Global E-waste Monitor report estimates there is US$91 billion worth of metals embedded in 2022 e-waste.

If e-waste management is improved, it "could result in a global net positive of US$38 billion, representing a significant economic opportunity while addressing climate change and health impacts," says Ruediger Kuehr, senior manager of the Sustainable Cycles program, in a press release on the report.

In May 2024, several companies and organizations announced the formation of a new coalition to encourage e-waste recycling on a local scale. The new Circular Supply Chain Coalition

is governed by Pyxera Global, Sustain Our Future, and Metabolic, with FedEx directing the implementation.

As explained on the coalition's website, modern waste infrastructure is often placed in low-income neighborhoods, and jobs managing discarded materials usually pay subpar wages. The founding partners "aim to change the situation by creating systems that distribute material value through networks rooted in and powered by frontline communities."

They plan to establish networks of small businesses and nonprofits within a given city to process the e-waste, and then the networks will sell the recovered materials to a large clean energy technology manufacturer through a forward procurement financial mechanism called the circular services agreement.

To test the feasibility of this concept, the founding partners ran a five-month pilot program in Lebanon, Tenn., that ended in March 2024. The program provided consumers with free FedEx shipping labels to mail in their used laptops and tablets to the Electronics Reuse and Recycling Alliance, a Nashville-based information technology scrap management company, which collected the items and wiped the hard drives.

According to a *GreenBiz* article, the founding partners currently are planning to establish logistics hubs in Phoenix, Ariz., Atlanta, Ga., and Cleveland, Ohio. They are seeking new partners to help establish these and other local networks.

Solar panel breakage on the rise

Even as governments and companies around the world race to embrace solar energy to reduce their carbon emissions and help curb climate change, the increasing frequency and severity of hailstorms stymies installation in hail-prone regions that could greatly benefit from this emerging energy source, such as the Great Plains of the United States and the Pampas in northern and central Argentina.

Credit: U.S. Department of Energy, Flickr

Solar installers and volunteers construct a community solar array in Norwood, Colo. Installation of solar panels in the U.S. Great Plains region is hindered by the increasing frequency and severity of hailstorms.

To improve the resistance of photovoltaic modules to hail damage, thicker front glass panels is an excellent approach, as shown in a September 2023 *CTT* that summarized a study by researchers in India and Hong Kong. Yet paradoxically, the recent trend in solar panel manufacturing is to make the glass thinner than before. This decision has led to an increase in spontaneous glass breakage even under normal conditions of use, as detailed in the Renewable Energy Test Center's sixth annual PV Module Index Report.

The report, which published in June 2024, discussed the phenomenon of spontaneous glass breakage with Teresa Barnes, who manages the Photovoltaic Reliability and System Performance group at the National Renewable Energy Laboratory.

In the interview, Barnes notes that when she first started working on solar module reliability seven or eight years ago, she mostly heard about glass breakage in cases of sloppy operations or maintenance practices. Now, though, "People are seeing glass breakage for no apparent reason, often before commissioning," she says.

While these field reports are anecdotal, they mirror reports coming from the testing labs.

"It used to be the case that modules would pass the IEC 61215 static load test

Corporate Partner news

CeramTec revives SPK brand, expands machining offerings

CeramTec announced that all machining activities will now fall under the name SPK by CeramTec. This name pays homage to the company Südplastik Gummi-und Kunststoff-Verarbeitung GmbH (SPK), which was one of the original companies acquired to form today's CeramTec. Read more: https://www.ceramtec-group.com/en/news-events

Elkem Materials announces new vice president of corporate communications and public affairs

Elkem Materials Inc., a provider of advanced silicon-based materials, welcomed Marianne Stigset as vice president of corporate communications and public affairs. Stigset will be "instrumental in fostering strong collaboration with Elkem's key stakeholders and enhancing our strategic positioning as a leading, global player within sustainable silicon-related products," says Elkem CEO Helge Aasen. Read more: https://www.elkem.com/media/news/article/?itemid=CA4E40737CE992BA

NSL Analytical Services acquired by Levine Leichtman Capital Partners

In June 2024, NSL Analytical Services announced that it will be acquired by Los Angeles-based private equity firm Levine Leichtman Captial Partners. NSL provides materials testing for a wide range of sectors, including aerospace and defense, electronics, advanced materials, and more. NSL laboratories will remain based in Cleveland, Ohio. Read more: https://www.nslanalytical.com/category/news

Rauschert works to purify wastewater with zero liquid discharge approach

Rauschert Industries Inc., a manufacturer of technical ceramics, plastic molded parts, and functional components, is working to develop special ceramic membranes for a zero liquid discharge approach in hospitals to purify and reuse wastewater. Practical implementation of the approach is being tested by researchers in the Department of Psychiatry and Psychotherapy at Jena University Hospital. Read more: https://rauschert.com/en/news ■

with a big safety factor. Today, modules are either barely passing the base static load test or they are not passing with higher safety factors. Some new module designs are simply not passing the minimum static load test," Barnes says.

The reason thinner glass panels experience this failure mode more often than standard or thicker panels is because it cannot be fully tempered, Barnes explains.

"... [Any] manufacturer can temper glass that is 3 mm or thicker because it is relatively easy to get the thermal differential to build the stress profile you need," she says. "However, it is more difficult to fully temper glass below a thickness of 3 mm. If you do not have a good temper on the glass, it is relatively easier for the glass to break."

In addition, Barnes notes that the way people are cleaning or grinding around the edges of the glass may cause more rather than fewer defects, "perhaps making this thinner glass even more sensitive to breakage." Plus, the concurrent trend of developing ultralarge modules results in the glass bearing more of the load, "which may be bad because we have made the glass weaker," Barnes says.

Fortunately, it appears that manufacturers are becoming more aware of the drawbacks that come with ultrathin module design. Barnes says that at this year's PV Module Reliability Workshop, hosted annually by the National Renewable Energy Laboratory, manufacturers reported a trend back toward thicker frames and wider mounting rails to help optimize how loads are balanced out.

You can download the full 2024 PV Module Index Report at https://retc-ca.com/pvmi. ■

Industrial IoT: Global markets

By BCC Publishing Staff

The global market for industrial internet of things (IoT) technologies and devices was valued at $124.7 billion in 2022 and is expected to grow at a compound annual growth rate (CAGR) of 21.6% to reach $391.8 billion by 2028.

Table 1. Global market for industrial IoT, by offerings, through 2028 ($ millions)

Offerings	2022	2023	2028	CAGR % (2023–2028)
Hardware	66,101.9	77,278.7	196,415.4	20.5
Solutions and platforms	44,301.4	52,928.4	149,895.5	23.1
Services	14,308.0	16,964.7	45,512.0	21.8
Total	124,711.3	147,171.8	391,822.9	21.6

Industrial IoT refers to the use of smart actuators and sensors to optimize processes and enable automation within industrial and manufacturing operations. However, alongside productivity improvements, adoption of this technology also poses security risks. For example, there is the possibility of theft of device data or business data, cyber-attacks such as denial of service and distributed denial-of-service, data breaches, and device siphoning.

The market is segmented into hardware, solutions and platforms, and services (Table 1). The solutions and platforms segment is expected to grow at the highest CAGR of 23.1% during the forecast period, mainly because of the need to drive operational efficiency and innovation across industries.

Some key emerging technologies for industrial IoT include

- **5G networks**, which offer robust connectivity for many IoT devices simultaneously. This ability is critical in industrial environments where numerous sensors and machines need to communicate seamlessly.
- **Edge computing and fog computing**, which allow for a combination of local and distributed processing and thus improves the efficiency, reliability, and scalability of industrial IoT applications.
- **Blockchain**, or a distributed ledger that enables the transaction and validation process without the involvement of third parties. Transactions in blockchain are traceable for all authorized users, ensuring the industrial IoT systems' trustworthiness.
- **Machine learning**, which allows organizations to extract more insights from structured and unstructured data compared to traditional business intelligence solutions.
- **Digital twins technology**, which creates a comprehensive and constantly refreshed virtual counterpart of a physical object or activity that can be used to test multiple scenarios, track performance, identify opportunities for improvement, and predict problems.

Currently, the majority of industrial IoT solutions are deployed on-premises due to the ease of customizing and controlling industrial IoT devices and systems within an organization's own infrastructure, the avoidance of data and messaging costs, and better security of industrial assets. However, cloud deployments are expected to grow during the forecast period due to their capacity to provide scalable, flexible, and cost-effective solutions.

In 2022, large enterprises accounted for 78% of the industrial IoT market share. But as industrial IoT solutions become more affordable, scalable, and easier to implement, such as with the adoption of cloud deployments, smaller organizations are expected to increasingly leverage industrial IoT technologies to improve their operational efficiency, enhance customer experience, and gain a competitive edge in the market.

The manufacturing segment accounted for the largest share of the market with 33.6% in 2022. However, the healthcare sector is poised to be the fastest-growing industry throughout the forecast period due to the increasing demand for advanced healthcare solutions and the potential for transformative benefits.

Asia–Pacific led the industrial IoT market in 2022 with a market share of 37.3% due to its strong manufacturing environment, quick uptake of new technologies, and policies encouraging digital transformation. The North American region came in second, with the U.S. being by far the largest industrial IoT market in this region, accounting for 79.3% of the region's market in 2022. This dominance is driven in part by the U.S. government's support for digital transformation and cybersecurity as well as the development of IoT standards and laws, which have encouraged businesses to adopt industrial IoT solutions.

About the author

BCC Publishing Staff provides comprehensive analyses of global market sizing, forecasting, and industry intelligence, covering markets where advances in science and technology are improving the quality, standard, and sustainability of businesses, economies, and lives. Contact the staff at Helia.Jalili@bccresearch.com.

Resource

BCC Publishing Staff, "Industrial IoT (IIoT): Global markets," BCC Research Report IFT299A, May 2024. https://bit.ly/BCC-May-2024-industrial-IoT ■

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SOCIETY DIVISION SECTION CHAPTER NEWS

ACerS leaders for 2024–2025

ACerS is pleased to introduce the 2024–2025 Society leadership. New officers and directors will be installed at the 126th Annual Business Meeting on Oct. 7, 2024, at ACerS Annual Meeting at MS&T24 in Pittsburgh, Pa.

Society officers and directors

Executive Committee

Ferraris

President
Monica Ferraris
Full professor of science and technology of materials
Politecnico di Torino
Turin, Italy

Mecklenborg

Secretary
Mark Mecklenborg
Executive director
The American Ceramic Society
Westerville, Ohio

Affatigato

President-elect
Mario Affatigato
Fran Allison and Francis Halpin Professor of Physics
Coe College
Cedar Rapids, Iowa

Board of Directors (new)

Berndt

Christopher C. Berndt
University Distinguished Professor
Swinburne University of Technology
Melbourne, Australia

Bordia

Past President
Rajendra Bordia
George J. Bishop III Chair Professor of Ceramic and Materials Engineering
Clemson University
Clemson, S.C.

Guo

Ruyan Guo
Robert E. Clarke Endowed Professor of electrical and computer engineering
The University of Texas at San Antonio
San Antonio, Texas

Tipsord

Treasurer
Dan Tipsord
General manager
Trans-Tech
Adamstown, Md.

Trice

Rodney Trice
Professor
School of Materials Engineering
Purdue University
Lafayette, Ind.

FOR MORE INFORMATION:

ceramics.org

Board of Directors (returning)

Navrotsky

Alexandra Navrotsky
Regents Professor
Director
Navrotsky Eyring Center for Materials of the University
Arizona State University
Tempe, Ariz.

Reigel

Marissa Reigel
Senior R&D manager
Saint-Gobain NorPro
Stow, Ohio

Freiman

Parliamentarian
Stephen Freiman
Freiman Consulting Inc.
Potomac, Md. ■

Steyer

Todd Steyer
Chief engineer for materials and manufacturing R&D
The Boeing Company
Huntington Beach, Calif.

Cesarano

Joseph Cesarano
President and founder
Robocasting Enterprises LLC
Albuquerque, N.M.

Singh

Dileep Singh
Senior scientist and group leader
Applied Materials Division
Argonne National Laboratory
Argonne, Ill.

Wong-Ng

Winnie Wong-Ng
Research chemist
National Institute of Standards and Technology
Gaithersburg, Md.

ACerS offers reduced dues for members in developing and underdeveloped countries

The American Ceramic Society's core purpose is to serve its members. One of the ways the Society upholds this purpose is to develop a strategic plan with specific goals.

Under the current strategic plan (2022–2024), increasing the number of international members within the Society is a major goal.

"ACerS has long valued the engagement and leadership of our international members who have enriched the society in multiple ways," says Rajendra Kumar Bordia, ACerS president. "The scientific and technological enterprise benefits greatly from collaborations and learning from international colleagues."

Among the initiatives underway to accomplish this goal, the Society is now offering reduced dues membership options for professionals and graduate students who currently reside in developing and underdeveloped countries. Eligible countries are based on those defined as Low-Income or Lower-Middle-Income Economies by the World Bank: https://ceramics.org/world-bank-classifications-for-developing-countries.

Membership type	Low-Income Economy	Low-Middle-Income Economy
Individual	$30 USD	$60 USD
GGRN	$7.50 USD	$15 USD

"In multiple discussions with our international members, we have learned that, in some countries, one of the barriers to joining ACerS is high cost of annual memberships," Bordia says. "This initiative is a direct result of ACerS being sensitive and responsive to the needs of our international members."

New members may learn more about the reduced dues offer and apply by visiting ceramics.org/reduced-dues-membership. Current ACerS members that reside in these areas will have the opportunity to renew their ACerS Individual or GGRN membership at the reduced rate(s) shown in the table.

"We request ACerS members to encourage their colleagues who reside in the developing and underdeveloped countries to take advantage of this program and join ACerS," Bordia says. ■

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David John Green, ACerS past president and DLM, 1947–2024

David John Green died on Aug. 13, 2024, at the age of 76. He was an ACerS Fellow (1991), past president (2013–2014), and Distinguished Life Member (2015).

Originally from Manchester, England, Green graduated with a B.S. in chemistry from the University of Liverpool, England, and with M.S. and Ph.D. degrees in materials science from McMaster University, Canada. During his graduate studies, he worked on microstructural aspects of fracture in ceramic materials. In particular, he demonstrated the importance of microcracking in the fracture of zirconia-based materials and also developed a specialized technique called ultrasonic fractography for studying crack–particle interactions in brittle materials.

In 1975, Green joined the Canadian Federal Government to work in the Department of Energy, Mines, and Resources. The primary emphasis of this work was concerned with the preparation of ultrafine, homogeneous ceramic powders for the fabrication of solid electrolytes for use in energy conversion and storage systems.

Joining Rockwell International Science Center in 1979, Green continued to study the relation between fabrication, microstructure, and the properties of ceramic materials. In particular, he contributed to the design of the heat shield and other aspects of the Space Shuttle projects during this time.

From 1984 until his retirement in 2013, Green served as a faculty member in the Department of Ceramic Science and Engineering at The Pennsylvania State University. His research on the mechanical behavior of porous ceramics during sintering and in use, as well as on the design of residual stresses to strengthen and arrest cracks in brittle materials, gained significant global attention.

Elizabeth Dickey, the Teddy and Wilton Hawkins Distinguished Professor at Carnegie Mellon University, remembers her time at Penn State with Green fondly.

"As a graduate student, I looked up to Dave as a luminary in ceramics research. As a colleague, I had the privilege of witnessing his dedication as an educator and mentor. As a friend, I cherished his passion for life and his genuine love for his wife, Keiko. I will remember him as a true gentleman, whose great optimism and spirit touched everyone he met," she says.

Green was an active member of The American Ceramic Society. Notably, he served as vice president of the Publications Committee (1994–1996) and as senior editor of *Journal of the American Ceramic Society* (2003–2016). In these roles, he focused on ensuring a fair, fast, and comprehensive paper review process, which "made a real difference," says Mark Mecklenborg, ACerS executive director.

Green was not only committed to inclusive participation within ACerS journals but the Society as a whole, as evidenced by his priorities as ACerS president. During his presidential year, he formed a committee to identify and suggest solutions to improve diversity within the Society. He also worked to strengthen ties between ACerS and other ceramic societies in the Americas, as well as helped lead the rollout of the newly established Ceramic and Glass Industry Foundation in 2014.

In 2005, Green was awarded the Basic Science Division's Robert B. Sosman Award, which recognizes outstanding achievement in an area of basic science that results in a significant impact on the field of ceramics.

Green leaves behind many close colleagues and friends, including Bill Fahrenholtz, past editor-in-chief of *Journal of the American Ceramic Society* (2017–2022).

"In Fall 2016, before I assumed the position of editor-in-chief of *JACerS*, we had several meetings in which he helped me learn the complexities of the editorial management system as well as the more practical aspects of overseeing the journal," Fahrenholtz says. "I had the utmost respect for David's accomplishments as journal editor and as a ceramic researcher."

Outside of research and ACerS, Green enjoyed ballroom dancing with his wife, Keiko Green. As he would often say with a smile, "We'll ballroom dance to the Beatles if we have to!" ■

Greater Missouri Section/Refractory Ceramics Division 60th Annual Symposium: March 26–27, 2025

The ACerS Greater Missouri Section and Refractory Ceramics Division will coorganize the 60th Annual Symposium on Refractories from March 26–27, 2025, in St. Louis, Mo., at the Hilton St. Louis Airport Hotel. This year's theme is "Modeling and simulation and its potential and practical use in the refractory industry." Co-program chairs are Rebecka Annunziata of Arcelor Mittal and Brady Gould of Christy Refractories. A kickoff event will be held the evening of March 25, 2025.

For further information, please contact Patty Smith at (573) 341-6265 or psmith@mst.edu. ■

GOMD announces travel stipend for students presenting at ICG 2025

The ACerS Glass & Optical Materials Division is sponsoring eight stipends in the amount of $1,000 each to help support students attending ICG 2025 in Kolkata, India. These stipends are for students who have submitted and have been accepted to present their abstract at the conference. The stipends will be awarded to students from eight different universities.

For more information and how to apply, visit https://ceramics.org/gomd-student-stipend-for-icg-2025. ■

Mark your calendars: 2025 ACerS Mentor Programs registration opens soon

ACerS Mentor Programs facilitate knowledge transfer, skill development, and career guidance by pairing seasoned professionals with emerging talents. These year-long programs are offered for students, faculty, and industry.

Registration to participate as a mentor or mentee in the 2025 ACerS Mentor Programs will open in **fall 2024**. Learn more at https://ceramics.org/mentorship. ■

MEMBER HIGHLIGHTS

Volunteer Spotlight: Ricardo Castro

ACerS Volunteer Spotlight profiles a member who demonstrates outstanding service to the Society.

Ricardo Castro is chair and professor in the Department of Materials Science & Engineering at Lehigh University. He received a B.S. in molecular sciences and a Ph.D. in metallurgical and materials engineering from the University of São Paulo, Brazil. Before joining Lehigh in the fall of 2022, Castro was a tenured professor at the University of California, Davis, for more than 14 years. He also served as associate dean of research and graduate studies for three years while at UC Davis, a role that gave him experience working on events and professional development programs.

Castro's work focuses on the fundamental understanding of nanomaterials and their behavior under processing and service in extreme environments, such as high temperatures, complex chemistries, and radiation.

Castro has a long history of activities with ACerS. After joining the Society as a member of the Basic Science Division in 2007, he started getting involved as a symposia organizer for ACerS Annual Meeting at MS&T in 2009. He is now vice president of the Basic Science Division, as well as editor-in-chief of ACerS' gold open-access journal, *International Journal of Ceramic Engineering & Science*.

Castro was awarded the Robert L. Coble Award (2014) and the Engineering Ceramic Division's Global Young Investigator Award (2015) for his accomplishments in the understanding of nanodensification. He became an ACerS Fellow in 2019.

We extend our deep appreciation to Castro for his service to our Society! ■

ACerStudent Engagement: Hugh Smith

Hugh Smith is a Ph.D. student studying materials science and engineering at Massachusetts Institute of Technology and serves as a member of the ACerS President's Council of Student Advisors (PCSA). Smith has volunteered for several outreach events through ACerS and currently serves as chair of the PCSA's Education Committee.

"I started engaging with ACerS and the PCSA as an undergraduate and have continued my engagement into graduate school. As this year's chair of the PCSA's Education Committee, I have worked to lower the barrier to entry to engage kids with materials science activities."

You can take advantage of these opportunities as well by becoming a student member of ACerS. Visit https://ceramics.org/members/membership-types to learn more. ■

FOR MORE INFORMATION:

ceramics.org/members

Names in the News

Members–Would you like to be included in the Bulletin's Names in the News? Please send a current head shot along with the link to the article to mmartin@ceramics.org. The deadline is the 30th of each month.

Credit: Andrew Layton, Missouri S&T

Richard Brow, left, and Kim Day at the TKD Foundation headquarters in Rolla, Mo.

The TKD Foundation, co-founded by the late Thomas E. "Ted" Day and his wife, Kimberly A. "Kim" Day, permanently funded the Richard K. Brow Chair of Glass Science endowment at Missouri University of Science and Technology.

The endowed chair is named after ACerS Distinguished Life Member and Fellow **Richard K. Brow**, Curators' Distinguished Professor of materials science and engineering. Brow joined Missouri S&T in 1998 as a professor of ceramic engineering and senior investigator in the Graduate Center for Materials Research. He was named chair of ceramic engineering in 2001 and was the founding chair of the materials science and engineering department. ■

Ceramic Tech Chat: Katrina Donovan

Hosted by ACerS Bulletin editors, Ceramic Tech Chat talks with ACerS members to learn about their unique and personal stories of how they found their way to careers in ceramics. New episodes publish the third Wednesday of each month.

In the July 2024 episode of Ceramic Tech Chat, **Katrina Donovan**, faculty member in the Department of Materials and Metallurgical Engineering at South Dakota School of Mines and Technology, discusses her expansive background across different materials, describes her current research on using local materials to create clays and ceramic glazes, and shares her numerous STEM outreach programs to help inspire and teach students and educators across the state.

Check out a preview from her episode, where she offers tips on how to conduct successful STEM outreach in rural areas.

"I think if you have a module or something you can share or an activity you like to do that is STEM focused, that is a powerful thing. You can plug it into different local events. For example, one of the groups I've been involved with every year is the Girl Scouts. They have what's called the Big STEM Day. I've worked with hundreds and hundreds of kids through that. Another big thing that has started coming up is Knowledge Bowl. Even though we're pretty rural, they'll do travel competitions even at a middle-school level."

Listen to Donovan's whole interview–and all our other Ceramic Tech Chat episodes–at https://ceramictechchat.ceramics.org/974767. ■

AWARDS AND DEADLINES

Nomination deadlines for Division awards: Jan. 15, Jan. 21, and Jan. 31, 2025.

Contact: **Vicki Evans | vevans@ceramics.org**

Division	Award	Deadline	Description
AACS	Anna O. Shepard	January 15	Recognizes an individual(s) who has made outstanding contributions to materials science applied to art, archaeology, architecture, or cultural heritage.
BSD	Early Discovery	January 15	Recognizes an early career member of ACerS who has demonstrated a contribution to basic science in the field of glass and ceramics.
BSD	Robert B. Sosman Lecture	January 15	Recognizes an outstanding achievement in basic science that results in a significant impact on the field of ceramics.
BIO	Young Scholar	January 31	Recognizes excellence in research among current degree-seeking graduate students and postdoctoral research associates.
BIO	Global Young Bioceramicist	January 31	Recognizes a young ceramic engineer or materials scientist who has made significant contributions to the area of bioceramics, for human healthcare around the globe.
BIO	Larry L. Hench Lifetime Achievement	January 31	Recognizes an individual's lifetime dedication, vision, and accomplishments in advancing the field of bioceramics, particularly toward innovation in the field and contribution of that innovation to the translation of technology toward clinical use.
BIO	Tadashi Kokubo	January 31	Recognizes an individual's outstanding achievements in the field of bioceramics research and development.
CEMENTS	Early Career	January 31	Recognizes an outstanding early career scientist who is conducting research in the field of cement and concrete in academia, industry, or a government-funded laboratory.
GOMD	Norbert J. Kriedl	January 21	Recognizes a young engineer or materials scientist who has conducted excellent research in glass science. Nominations are open to all degree-seeking graduate students (M.S. or Ph.D.) or those who have graduated within a twelve-month period of the annual GOMD meeting.
GOMD	George W. Morey	January 21	Recognizes new and original work in the field of glass science and technology. The criterion for winning the award is excellence in publication of work, either experimental or theoretical, done by an individual.
GOMD	L. David Pye Lifetime Achievement	January 21	Recognizes an individual's lifetime of dedication, vision, and accomplishments in advancing the fields of glass science, glass engineering, and glass art.
GOMD	Stookey Lecture	January 21	Recognizes an individual's lifetime of innovative exploratory work or noteworthy contributions to outstanding research on new materials, phenomena, or processes involving glass that have commercial significance or the potential for commercial impact.
MFG	John E. Marquis Memorial Award	January 15	Recognizes the author(s) of a paper on research, engineering, or plant practices relating to manufacturing in ceramics and glass, published in the prior calendar year in a publication of the Society, that is judged to be of greatest value to the members and to the industry. ■

FOR MORE INFORMATION:

ceramics.org/members/awards

CERAMIC AND GLASS INDUSTRY FOUNDATION

CGIF collaborates with Belden Brick Company on Industry Tour for Teachers

By Charlee Gutridge, CGIF intern

Bricks are known as much for their durability as they are for their aesthetic appeal. Whether viewing the warm reds and browns one typically associates with traditional brick, or the sleek glazed brick designs adorning modern hospitals and universities, brick offers a remarkable range of possibilities.

For more than 100 years, The Belden Brick Company has been at the forefront of brick industry changes, adding innovation and guidance at their brick plants in Sugarcreek, Ohio. These innovations would not be possible without a passion for brickmaking. This passion led the leadership at Belden to collaborate with the Ceramic and Glass Industry Foundation (CGIF) on an Industry Tour for Teachers.

Industry Tours for Teachers is an ongoing program by the CGIF to give educators a behind-the-scenes look at different companies in the ceramic and glass materials communities. The tour at Belden took place on June 27, 2024. It began with a warm welcome from Bob Belden, CEO and vice president of operations at Belden. Bob is a fifth-generation brickmaker, and his knowledge and passion for the industry was apparent from his first introduction. He shared the company's long history of quality brickmaking and then introduced several other tour guides, all executives within the company who had taken time out of their day to share their company with the visiting educators.

A Belden Brick employee, left, explains to teachers how bricks are made during the CGIF Teacher Industry Tour on June 27, 2024.

The teachers were split into small tour groups of four or five, and each group learned about the decades of brickmaking innovation from the very people that run the daily operations. From workers individually scoring and hand laying bricks in almost 100-year-old beehive kilns, to bricks being dried in kilns the size of a football field, to automated machines cutting and laying brick by the hundreds, educators gained a deep understanding of brick and its importance to today's world.

To learn more about the Belden Brick industry tour and view other events and program offerings from the CGIF, visit the CGIF website at https://foundation.ceramics.org. ■

research briefs

Reprogramming the polarization of magnetic cilia allows their use in new applications

In a novel development, researchers at North Carolina State University discovered a simple way to reprogram the magnetic polarization of magnetic cilia, opening the door for them to be repurposed for new functions or applications.

Magnetic cilia are synthetic versions of cilia, or the tiny, hair-like structures that cover some microorganisms and beat in a coordinated, whip-like manner to propel the cell. The synthetic version, which consists of hair-like polymers embedded with magnetic particles to power the movement, could be used to help microsized robots navigate the human body.

Most magnetic cilia make use of "soft" magnets, meaning they only become magnetized in the presence of a magnetic field. In contrast, "hard" magnets can produce their own magnetic field and thus offer greater control over the movement of magnetic cilia. But so far, only a few studies have made use of "hard" magnets in magnetic cilia.

In the recent open-access study, the NC State researchers created magnetic cilia using "hard" neodymium magnets. But the true novelty of their work lies in the fact that after endowing the particles with a specific magnetic polarization, the particles' polarization could later be reprogrammed, "which in turn allows us to completely change how the cilia flex," says senior author Joe Tracy, professor of materials science and engineering at NC State, in a press release.

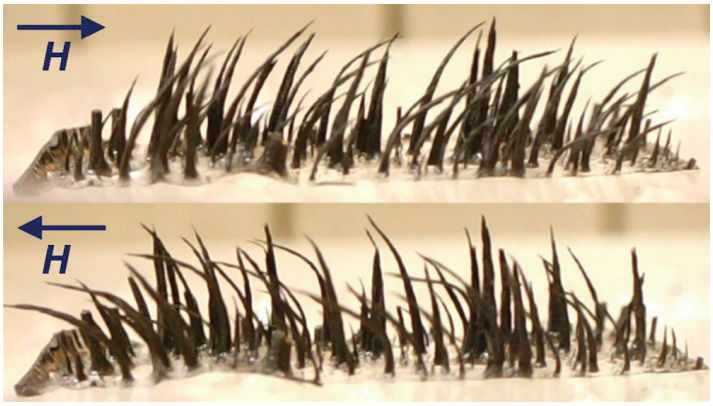
To create the magnetic cilia, the researchers embedded NdFeB microparticles (5 µm) in Irogran, a thermoplastic polyurethane, through solvent casting. They placed the slurry in a vertical magnetic field during the casting process to give all the microparticles the same magnetization. Then, they applied a less powerful magnetic field as the liquid polymer dried to align the magnetization directions of the microparticles and space the magnetic cilia regularly across the substrate.

To reprogram the microparticles' polarization, the researchers first embedded the magnetic cilia in ice to restrain them from bending during the reprogramming process. They then exposed the mag-

Research News

Pilot study uses recycled glass to grow plants for salsa ingredients

Researchers at The University of Texas Rio Grande Valley investigated if it was possible to partially substitute soil with recycled glass fragments because, if so, it would solve two problems at once: reduce landfill waste while growing edible vegetables. Their pilot study found that the glass-filled soil sped up plant development and reduced unwanted fungal growth for several common salsa ingredients, namely cilantro, bell pepper, and jalapeno. These results are particularly promising because the study was done without fertilizers, pesticides, or fungicides. For more information, visit https://www.acs.org/pressroom/presspacs/2024.html.



Credit: Matthew R. Clary, North Carolina State University

Bending of NdFeB-based magnetic cilia magnetized pointing up in horizontal magnetic fields.

netic cilia to a damped, alternating magnetic field, which reset the magnetization of the microparticles. Finally, they applied a strong magnetic field to magnetize the microparticles in a new direction.

In the press release, first author Matt Clary, Ph.D. student at NC State, explains the importance of resetting the magnetization before attempting to reprogram the microparticles.

"If you leave out that erasing step, you have less control over the orientation of the microparticles' magnetization when reprogramming," he says.

In addition to the experimental process, the researchers developed a computational model that allows users to predict the bending behavior of magnetic cilia based on the orientation of the microparticles' polarization. This model could help other research groups explore the development of "hard" magnetic cilia and related soft actuators.

"Ultimately, we think this work is valuable to the field because it allows repurposing of magnetic cilia for new functions or applications, especially in remote environments," Tracy says. "Methods developed in this work may also be applied to the broader field of magnetic soft actuators."

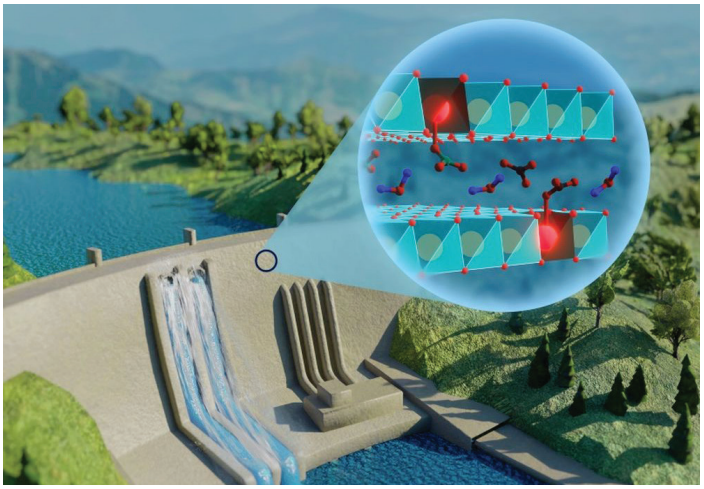
The open-access paper, published in *Advanced Materials Technologies*, is "Magnetic reprogramming of self-assembled hard-magnetic cilia" (DOI: 10.1002/admt.202302243). ■

Unlocking the last lanthanide

Researchers led by Oak Ridge National Laboratory used X-ray absorption spectroscopy to observe how the rare lanthanide element promethium forms chemical bonds when placed in an aqueous solution. Despite its rarity, promethium has a few interesting applications, including radiation therapy and creating long-lasting atomic batteries for pacemakers and spacecraft. However, because of its high instability, there remain many unknowns about this radioactive metal. The chemical properties uncovered by this study opens a new realm of research possibilities. For more information, visit https://www.bnl.gov/newsroom/news.php?a=221938. ■

ceramics in manufacturing

Luminescent material offers real-time analysis of concrete deterioration



Credit: Danilo Mustafa, *Chemical Communications* (CC BY 3.0)

Researchers led by the University of São Paulo's Physics Institute developed a luminescent material that can indicate the degree of carbonation in concrete structures. This image illustrates the absorption and interaction of carbonates with europium in the concrete structure.

Researchers at the University of São Paulo's Physics Institute in Brazil, in collaboration with colleagues at the University of Leuven in Belgium and the University of Kiel in Germany, developed a luminescent material that can indicate the degree of carbonation in concrete structures in a nondestructive manner.

Carbonation is a chemical reaction that can occur within reinforced concrete structures. It lowers the pH of the concrete and can make the reinforcing bars more susceptible to corrosion when exposed to moisture and oxygen.

The degree of carbonation in a concrete structure is typically determined by removing a small piece of the structure and then spraying it with a phenolphthalein solution. The phenolphthalein turns bright pink when in contact with pristine concrete, but its color fades or completely disappears when carbonation has occurred.

This procedure is detrimental to the concrete structure because it requires drilling holes in the composite, affecting its structural integrity. A method for determining the degree of carbonation without destroying the structure is preferable because the concrete could then be monitored without affecting its mechanical properties.

In the recent study, the researchers used zinc aluminum layered double hydroxide (LDH), which is reported to improve the durability of concrete, as a host material for europium ions, which have photoluminescence properties. When the LDH absorbs carbonates, or the materials that result from the carbonation of concrete, it causes a change in the europium coordination num-

ber. As more carbonates are absorbed, the luminescence of the europium ions under ultraviolet light shifts from orange to red.

A São Paulo Research Foundation press release reports that the researchers are now developing a sensor that detects the luminescent material within concrete structures. They will then test the luminescent material under real-world conditions to verify its weatherability and stability inside concrete.

The open-access paper, published in *Chemical Communications*, is "Eu^{3+} doped ZnAl layered double hydroxides as calibrationless, fluorescent sensors for carbonate" (DOI: 10.1039/D3CC03066K).

Building slag resistance: Effects of corundum aggregate type on hot metal ladle bricks

Researchers in China investigated the effects of different corundum aggregates on the slag resistance of Al_2O_3-SiC-C bricks.

Al_2O_3-SiC-C bricks are widely used in hot metal pretreatment equipment, such as hot metal ladles and torpedo tanks, because of their excellent resistance to oxidation, slag corrosion, permeability, and thermal shock. But as metallurgical material developments lead to hotter and more corrosive processing environments, the required mechanical properties and slag resistance of refractories are becoming more stringent.

Currently, there are many types of corundum refractory aggregates used to create Al_2O_3-SiC-C bricks. For this study, the researchers tested the effects of using bauxite, fused brown corundum, tabular corundum, fused white corundum, and microporous corundum.

Their tests revealed two characteristics of the corundum aggregate that most affect the brick's slag resistance:

- Impurity phase content of the aggregate. When the aggregate is in contact with the slag, the impurity phase in the aggregate is more likely to react with the slag and aggravate the corrosion of the slag on the aggregate.
- Microstructure of the aggregate. The microcracks in the aggregate, or the through-holes produced by re-sintering, will provide a channel for slag corrosion and aggravate the corrosion of the slag on the aggregate.

Of the five corundum aggregates tested in this study, bricks made with tabular corundum, which had lower porosity and impurity content, exhibited the best slag resistance.

But with this newfound knowledge of the aggregate structure–property relationship, "The scope of the study can be expanded to conduct more comprehensive and systematic research," the researchers conclude.

The paper, published in *International Journal of Applied Ceramic Technology*, is "Effect of aggregate type on the mechanical properties and slag resistance of Al_2O_3-SiC-C hot metal ladle bricks" (DOI: 10.1111/ijac.14589). ■

United States of America:

Market giant with great expectations

Membrion's flexible ceramic desalination membranes, shown here, are resistant to harsh industrial wastewater.

Credit: Greg Newbloom, Membrion

By Randy B. Hecht

U.S. companies, universities, and institutions assess the next-generation talent, technologies, and climate-friendly practices needed to sustain global leadership.

The United States has always favored people and entities who like to run on the fast track. These days, however, businesses are facing challenges that do not always support moving at full speed.

From resolving supply chain and labor constraints to adopting new sustainability standards and computer technologies, U.S. organizations are contending with a complicated environment for achieving their R&D and growth goals.

Rajendra Bordia, the George J. Bishop III Endowed Chair and professor of ceramics and materials engineering at Clemson University, has witnessed firsthand the effect of and response to these challenges in the ceramics and glass industry during his time as ACerS president (2023–2024).

For example, though artificial intelligence (AI) and machine learning methods have captured people's imaginations with their potential for transformation, many businesses have yet to clarify how they would use these techniques and how they would get a return on their investment in it. But "I'm confident that we will start to see its implementation in terms of both product development and process optimization," says Bordia.

Sustainable manufacturing practices, on the other hand, are already becoming embedded in product development, operations, and pursuit of emerging market opportunities.

"Ceramics and glasses have been very important in sustainability for a long time. Even if you think about a simple thing like a refractory brick used in furnaces or production facilities, its purpose is to reduce thermal losses and improve the efficiency of that particular process," Bordia notes. "From my point of view, ceramics will be absolutely critical for sustainable and low-environmental-impact energy conversion and storage, including carbon capture and utilization."

Making these strides will require a reliable talent pool. To ensure an adequate supply of trained professionals, Bordia advocates including every generation that wants to be part of the workforce. He encourages employers to consider nontraditional approaches to late-career staff members, such as offering them the opportunity to transition to part-time work for several years before they move into full retirement.

"I think the best ideas, innovations, and advances will come from a combination of the young talent trained in these novel approaches and platforms and the older workforce's experience in terms of what is useful and needed in the market," he says. "They can guide and work with these younger colleagues to use the new tools to satisfy those needs."

That is especially important from his perspective as a university professor because "we are seeing a decreased interest in what we call hardcore or traditional engineering disciplines."

"There's a lot of interest in computer science and a fair amount of interest in bioscience and biomedical technologies, but there is less interest in things like mechanical, materials science, chemical, and electrical engineering," he says. He encourages companies that want to recruit from that smaller talent pool to partner with academic institutions and offer internships or co-op opportunities.

Bordia notes that ceramics will have a significant role to play not only in sustainability but also in national security and defense—and, by extension, sectors such as aerospace.

"Ceramics are critically important in everything from space exploration to hypersonic vehicles. Significant progress is being made in ceramics in electronic systems, including sensors and actuators. Biomaterials is another exciting area, particularly with the increased focus on individualized medicine," he says.

The following sections demonstrate how these myriad market factors shape policy and decision-making at establishments both large and small through interviews with leaders in industry, academia, and the government. Despite the challenges, these experts still express a strong passion and drive to advance materials research and application in the U.S.

Overall, "It's a very exciting time for ceramics," Bordia says.

Industry perspectives: Startups and niche markets

Silica-necting the dots to clean water

A conversation with Greg Newbloom, founder and CEO of Membrion

"Electroceramic desalination for harsh industrial wastewater" is the sort of phrase that would not exactly have drawn a crowd at a party a generation ago. But in today's sustainability-savvy world, Greg Newbloom and his team have a hot topic in play.

Newbloom is founder and CEO of Membrion, a Seattle-based startup focused on the reclamation of industrial wastewater. Their patented filtration and reclamation systems aim to eliminate unnecessary pre-treatment stages, offering a simplified and tailored solution for wastewater treatment.

A fresh perspective, a new opportunity

Newbloom says the Membrion team invented their solution for industrial wastewater treatment while pursuing a solution for a different application.

"Initially, we were trying to develop a membrane for use within redox flow batteries," Newbloom says. "The membranes they use have to be in these really harsh environments with lots of acids and oxidizers. Most materials break down, and we were trying to find an alternative material that could withstand these really challenging applications."

That path led to silica gel materials such as those used to maintain freshness in packaging and that are very good at absorbing water.

"They have molecular-size pores," Newbloom says. "So instead of having those little silica gel beads, we made full sheets of it. We control the size of the pores and the surface chemistry, and that optimization made the sheets able to withstand these really harsh environments."

These silica sheets, pictured in the header image of this article, became a solution in search of an alternate problem.

"While these new batteries are unique and interesting, they're still very young in their commercialization cycle," Newbloom says. "So as a business, we really needed to look at other applications that could benefit from those same use cases. That's how we made our way into the water sector. We basically will remove anything that is ionic from the water stream."

Membrion's first full commercial system is now in operation, being used to treat wastewater for a microelectronics manufacturing company in Portland, Oregon. The solution is deployed under a "water treatment as a service" model, which means that in exchange for a fee-per-treated-gallon rate, Membrion handles water treatment operations for its customers.

Two more systems are expected to go online during the third quarter of 2024. For now, the company is focused on the North American market, but it is seeing demand for the product in Europe and Asia and may begin exploring those markets in the next year or two.

Tapping AI for data-driven performance

Like most companies, Membrion generates a high volume of data related to its processes and results monitoring. Newbloom notes that facilities do not always have a firm grasp on what their wastewater contains. With that in mind, the team is in the early stages of building datasets that can, via artificial intelligence and machine learning, increase customers' usage and waste predictability to optimize the system's performance. The long-term vision also includes enabling circularity of critical materials.

"In a lot of cases, we're working with valuable metals in these wastewater streams—things like copper, cobalt, nickel—so there is value in being able to recover the water and those metals and return both back to the value chain," Newbloom says. "That's where our customers get their cost savings and their return on investment for leveraging our system today. And in the long run, we will partner with existing technologies to valorize these metals and return those back to the supply chain as well."

Aiming for growth (talent pool permitting)

Newbloom says that Membrion has the production capacity in play to scale as demand grows and that "nothing outside of labor prevents us from producing more of these."

"Our membranes are produced roll in our facility, which is a high-volume production method, so from a production rate standpoint, we're not limited in the amount we can produce," he says. "But as we grow and scale, getting access to incredible people is always hard. They're in high demand for good reason."

Newbloom anticipates that sales and field services will be the two biggest growth areas in the coming 12–18 months, and he believes the company's sustainability strength will be a lure for people who want to "have a bigger impact—that's something that we certainly lean into as we recruit people."

Learn more about Membrion's current projects and future goals at https://membrion.com.

Additive advances and ambitions

A conversation with Ryan Bock, vice president of research and development at SINTX Technologies

SINTX Technologies (Salt Lake City, Utah) develops ceramic materials, components, and technologies that historically have been marketed to the medical sector; the company notes that "its products have been implanted in humans since 2008."

A leader in silicon nitride research and development, it has in recent years moved into additional lines of business by way of a series of acquisitions and partnerships. Today, its research facilities in Utah and Maryland are concentrated on three areas of focus: additive manufacturing of advanced ceramics and composites; traditional production of high-performance silicon nitride, biomedical, and aerospace components; and development of complex thermal barrier coatings for aerospace and energy applications.

United States of America: Market giant with great expectations

Additive technology multiplies R&D options

"The potential with printing ceramics is a huge focus. We're investing quite a bit in advancing our capabilities in that area in particular," says Ryan Bock, vice president of research and development at SINTX.

Currently, the company can print alumina, zirconia, and silica ceramics. But SINTX is working to advance the capabilities to print other ceramics, such as silicon nitride.

"We subtractively manufacture silicon nitride parts today. That's really the foundation of our company. We have traditionally done that with biomedical parts, in particular spine implants—more than 40,000 worldwide," says Bock.

As SINTX seeks new market opportunities for its silicon nitride, it is zeroing in on what Bock calls "quality-stringent areas or industries, such as aerospace." Areas of expanded investment and R&D activity include complex thermal barrier coatings and ceramic matrix composites. The company has been pursuing collaborations with other companies and government entities in support of its expansion plans.

Like many companies targeting substantial growth, SINTX has encountered challenges in recruiting and retaining the talent it needs.

"There are not enough people to go around, and there are no magic bullets," Bock says.

Although the company does not recruit from specific schools, Bock says SINTX holds schools with a special focus on ceramic engineering "in high esteem," and staff members in R&D and operations "are charged to stay in close contact with programs and key professors" at their alma maters.

Results begin with customer collaboration

Another common challenge is balancing the time demands of new solution development on one hand and post-launch customer support on the other. SINTX has adopted the strategy of bringing customers into the R&D process "as far along as they can get on the front end and bring them as far along as possible" to minimize restarts, Bock says.

That customer orientation extends to the company's approach to sustainability, and customer requirements regarding sustainability often reflect existing and emerging industry or regulatory requirements.

"We do the testing that the customers require of us, whether it be in that area or another," Bock says. "And we want to do what we can to make a positive impact right at a grand scale level. The great thing about our ceramic materials is that they have inherent benefits versus nonceramic materials, such as metals and polymers."

On June 18, 2024, SINTX announced that its board of directors had "initiated a process to explore potential strategic options" and had retained Ascendiant Capital Markets, LLC as "exclusive strategic advisor" to the board in this process.[1]

On Aug. 6, 2024, SINTX announced the retirement of B. Sonny Bal as president and chief executive officer.[2] He is succeeded in both roles by Eric K. Olson, who is described in the announcement as having been a "serial founder and entrepreneur in a broad range of medical device, diagnostic, biologic, and biomaterial companies" for more than 30 years. Bal remains chairman of the company's board of directors.

Learn more about SINTX's capabilities and plans for the future at https://sintx.com.

Industry perspectives: Market influencers

Long-term planning 'drives' a carbon-free future

A conversation with Ann Nicholson, Corning's vice president of investor relations

Since development of the ceramic catalytic converter in the 1970s,[3] Corning Incorporated (Corning, N.Y.) has helped lead the way in emissions control in the automotive and other industrial sectors. Even now, sustainability continues to drive both business and social priorities at Corning, which was named to *Time* magazine's "World's Most Sustainable Companies" list for 2024.

In an interview with *Bulletin* editor Lisa McDonald, Ann Nicholson, vice president of investor relations at Corning, shared insights on Corning's current work and plans to support a greener future for the ceramics and glass industry.

Q: Which application areas are the focus of investments and advancements right now?

Credit: Corning Incorporated

Example of Corning's DuraTrap® gasoline particulate filter technology, which helps gasoline-powered vehicles meet the latest real-world-driving emissions standards.

A: Emissions reduction—cleaning emissions from gas combustion engines—is one focus of research and development efforts. Engines are getting more sophisticated, so their emissions are changing, and regulations are continuing to tighten.

More broadly, we are investing in research to support a cleaner environment. We have research on carbon capture technologies, and then we have—and have always had—some kind of development in the energy storage space. A lot of times, renewable energy systems give you energy when you do not really need it, so you need to be able to store it for later release.

Q: Which manufacturing process steps are a focus for innovation?

A: We do not disclose anything specifically, but two broad categories are 1) improving yields so we are throwing less stuff in a landfill and 2) diverting materials from the landfill and recycling them back into new products. We do that with glass. We make a sheet of glass, trim the ends, and put those trimmed ends right back in the tank.

In addition, one of the biggest sources of energy usage during the manufacturing process is in the firing. We have engineers and scientists that focus on things such as burner technology to make the process more energy efficient.

Q: What are some of the biggest benefits and challenges to materials innovation within the United States?

A: The way we are organized, there are lots of opportunities to exchange information. We have a centralized research facility, and each of our scientists are involved in multiple projects. They work on teams that include ceramic engineers, mechanical engineers, and industrial engineers, among other specialties. So, there is ample opportunity to learn from different people and cross populate ideas.

The challenge is sometimes work–life balance. From a cost perspective, it makes sense for us to be in the region where the customer is. So, we have facilities in Europe, the U.S., and Asia, but that means you can be on the phone 24 hours a day. We recognize work–life balance is important, and we encourage our scientists to balance their schedules.

Q: Do differing regulations between various countries or regions affect your ability to conduct research and innovate?

A: We do not view regulations as limiting factors on innovation but more as guidelines to push us to be better, innovate more, and give our customers what they are looking for so that it meets those standards.

Innovation can take time, and it is hard to invent on a schedule. So, a key to navigating new regulations is to be looking ahead and anticipating those changes. For example, who is working on the next generation of emissions engines? Or what is happening in the world of hybrid vehicles? We call that planning "technology roadmaps."

Q: Looking ahead, what other developments is Corning prioritizing?

A: We have worked on emissions control within the automotive industry for decades, but we continue to explore other sectors where this technology can apply. We also have some teams looking at developing technical glasses to replace soda lime glass in certain applications.

Learn more about Corning's sustainability initiatives in the company's 2023 Sustainability Report at https://www.corning.com/worldwide/en/sustainability.html.

From home-grown to global competitor

A conversation with Chris Kraft, senior director of thermal and foundry commercial operations at HarbisonWalker International

As North America's biggest supplier of refractory products and services, HarbisonWalker International (HWI) serves a customer base that spans such industries as iron and steel, aluminum, copper and heavy nonferrous metals, ferrous foundry, glass, power generation, refineries and petrochemicals, chemicals, gasifiers, incineration, cement, pulp and paper, and lime.

Since February 2023, HWI has been part of Calderys Group, which has opened European, Middle Eastern, and African markets as well as Asia–Pacific markets to HWI solutions, including its "green steel" applications. The move makes it possible for HWI products to be manufactured at Calderys facilities that provide proximity to customers in those regions.

"As a combined organization, we can leverage what Calderys has globally and utilize that in the market in the Americas," says Chris Kraft, senior director of thermal and foundry commercial operations at HWI. "And similarly, what we have in the Americas can be offered in Europe, the Middle East, and APAC [Asia–Pacific]. Working through that has not been without challenges: figuring out who does what and how we're doing things. But it's also been fun."

Overcoming supply chain and talent pool concerns

The company has recovered well from COVID-19-era supply chain constraints, Kraft says. During that period, when conventional wisdom held that vendor diversification was key to maintaining access to materials, HWI sought to work more closely with its most reliable established suppliers. Risk management necessitated identifying alternative vendors and avoiding dependence on a single source, but "we were sticking with them through a crisis situation," Kraft says. "That collaboration helped put us in a better position, and we're continuing that moving forward."

Access to talent is another story, especially at HWI's manufacturing locations but also within the ranks of professionals at the company. The company maintains relationships with a core group of universities (among them Rutgers, Clemson, Ohio State, and the University of Missouri) to increase its access to graduating seniors through classroom guest lectures and on-campus job fairs or recruiting events. In addition, HWI's innovation group established joint projects with research institutes and universities to advance its R&D and widen its network of contacts in the next generation of talent.

But its relationship with the outgoing generation has presented challenges as well. Earlier this year, with an eye to organization-wide succession planning, HWI offered a voluntary retirement incentive that created opportunities for younger workers. At the same time, it resulted in a loss of knowledge

that available candidates cannot in all cases replace. This shift coincides with the trend toward delivery of more complex solutions that can necessitate a stronger customer support capacity.

Navigating the data dilemma

"Everyone wants to make decisions based on data, but the data needs to be converted to useful information that supports predictive analysis," Kraft says. "As a supplier, we're trying to understand our customers' needs and understand where they want to go. We then try to match our capabilities to help them make better informed decisions."

At this point, Kraft says they are not always sure exactly where they are going, or where they want to finish. Regardless, "this is very exciting to HWI, and we do believe that we are a great partner in this uncharted territory," he says.

Sustainability figures prominently in that equation in terms of customer and internal initiatives. One significant change is in recycling of unused materials. Kraft recalls how 30 years ago, customers were responsible for dealing with their stores of unused bricks. Today, HWI is developing programs for dealing with those surpluses in an environmentally responsible manner. The company is also analyzing its energy and water consumption, exploring waste reduction, and evaluating the impact that use of alternative fuels has on the refractories.

"New standards are being forced upon industry by regulations or standards. And when customers ask what we're doing for sustainability, we need to be able to answer that question for various reasons, but one is because it is the right thing to do," Kraft says.

Kraft says there is currently a lot of innovation regarding sustainability. If it all supports using less resources to do what they need to do, "That's great. I hope that continues," he says.

Learn more about HWI's latest sustainability initiatives at https://thinkhwi.com.

Academic perspectives

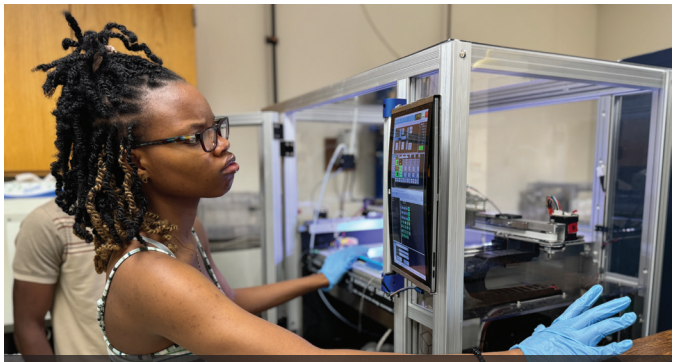
Cultivating engineers and opportunities

A conversation with Gabrielle Gaustad, dean of the Inamori School of Engineering at Alfred University

Young women entering the Inamori School of Engineering at Alfred University do not have to search far for a role model in a traditionally male-dominated field. The dean of the school, Gabrielle Gaustad, was once a first-year student there herself.

"I'm a product of our program: a ceramic engineering undergrad from Alfred University," she says. "Alfred has a great record of having women in the program. It was great for me as an undergrad to have a lot of female faculty and students around me. I didn't see a gap until I got out in the workforce."

Gaustad earned a Ph.D. in materials science and engineering at Massachusetts Institute of Technology and then worked in the aluminum and steel industries from both the waste management and manufacturing sides. She describes this time as "eye-opening" in terms of gender imbalances. Today, she sees diversity as something that needs to begin "even earlier than college" with outreach efforts that create more opportunities for students in less affluent school districts that are not equipped to offer advanced placement studies in subjects such as chemistry and physics.



Temitope (Temmy) Adeloye, an undergraduate student majoring in materials science and engineering at Alfred University, participates in the university's summer research opportunity program.

Credit: Caitlin Brown, Alfred University

Working to overcome disadvantages

"Those educational gaps probably start pretty young, and by the time the students enter college, there is not a ton we can do about those gaps," she says. "We have a couple programs for students that are a little bit on the bubble. We want to admit them, but we're worried that they might not have everything they need. We have some summer programming that brings them on campus early to see if we can identify gaps and try to fill them before they start as an engineer in the fall."

But economic circumstances can continue to have an impact even when students are succeeding in the program. There are relocation costs associated with accepting internships, such as securing housing and transportation. The school has tried to address these challenges through a summer research opportunity program that provides housing and a competitive stipend to cover other costs.

"I think that program has increased accessibility, so that if you have an economically disadvantaged background, you can take advantage of that opportunity," Gaustad says. "And now we're seeing a lot more internships that are providing housing along with the stipend, which again lowers barriers to accessibility for all students."

Powering up next-generation engineers

The school keeps track of which industries are hiring and which have seen student recruitment decline. Big growth sectors right now include aerospace, renewable energy, and

semiconductors, including advanced ceramics and glass or "anything computer or semiconductor adjacent," Gaustad says. Conversely, there are reduced opportunities for students hoping to enter automotive and traditional manufacturing.

Gaustad's students prioritize ongoing training and professional development, although the specifics of what that can mean varies by student and industry.

"A lot of our engineers will end up going through some kind of management track, but maybe they didn't have opportunities to take a business or management course during their undergraduate study," she says. "So, they're looking for leadership training, mentorship, and management training because that shows you do have a pathway toward leadership or management roles."

Championing the environment and entrepreneurship

As they transition from campus to careers, Gaustad sees students demonstrating a "super strong interest" in culture that includes sustainability. Plus, they can see through greenwashing.

"Companies that are using ESG [environmental, social, governance] metrics purely for marketing purposes? They're pretty savvy about that kind of thing," she says.

That awareness dovetails with her own work, which includes a decade and a half dedicated to recycling materials. At Alfred, that translates to a large glass recycling project conducted in connection with the New York State Department of Environmental Conservation. She also works on a project with the Army Research Laboratory to develop ultrahigh-temperature ceramic materials. Gaustad estimates that 40 undergraduates worked on those and other projects during summer 2024.

Students also enter school-organized pitch competitions to raise interest in entrepreneurship and working at startups.

"A few students have had success with that—starting a company, making some products, and doing well," Gaustad says. "We're probably just touching the tip of the iceberg, and we could grow that substantially."

MARKET SNAPSHOT

Buyer's market: A global giant sees continued trade deficits as export volume lags import demand

By Randy B. Hecht

The United States of America is the third largest country in the world in terms of area, behind Russia and Canada and just ahead of China. Its coastlines extend across more than 12,300 miles (19,900 kilometers), and its elevation runs from a depth of about –282 feet (–86 meters) at Death Valley to about 20,300 feet (6,190 meters) at Denali (which are, respectively, the lowest and highest points in North America).[a]

The record-setting continues in the global marketplace: The country is the world's largest importer and second largest exporter.[b] For 2023, imports totaled an estimated $3.832 trillion, down from $3.97 trillion in 2022 but rebounded from $3.409 trillion in 2021. China is the source of 18% of imports into the U.S., followed by Canada and Mexico (14% each), Germany (5%), and Japan (4%). Major imports include crude petroleum, cars, broadcasting equipment, garments, and computers.

Export volume for 2023 totaled an estimated $3.052 trillion, up slightly from $3.018 trillion in 2022 and significantly from $2.567 in 2021. Canada is the destination for 16% of U.S. exports, followed by Mexico (15%), China (8%), and Japan and the United Kingdom (4% each). Leading export commodities include refined petroleum, crude petroleum, natural gas, cars, and integrated circuits.

Based on the number of people ages 15 or older who are employed or seeking work, the U.S. had an estimated 2023 labor force of 170.549 million.

Real GDP was an estimated $24.662 trillion for 2023, which represents a growth rate of 2.54% from $24.051 trillion in 2022. That breaks down to an estimated per capita GDP of $73,600 for 2023, up from $72,200 in 2022.

The U.S. economy is largely dependent on the services sector, which generates 80% of GDP; industry accounts for 19.1% and agriculture for 0.9%. Despite that distribution, the CIA World Factbook notes that the U.S. has the world's second largest industrial output. Dominant industries include petroleum, steel, motor vehicles, aerospace, telecommunications, chemicals, electronics, food processing, consumer goods, lumber, and mining. The top 10 agricultural products, based on tonnage, are maize, soybeans, milk, wheat, sugarcane, sugar beets, chicken, potatoes, beef, and pork.

On July 12, 2024, the Bureau of Economic Analysis (BEA) announced preliminary statistics for new foreign direct investment in the U.S. for 2023.[c] According to the notice, "Expenditures by foreign direct investors to acquire, establish, or expand U.S. businesses totaled $148.8 billion. Expenditures decreased $57.4 billion, or 28%, from $206.2 billion in 2022 and were below the annual average of $265.6 billion for 2014–2022. As in previous years, acquisitions of existing U.S. businesses accounted for most of the expenditures...In 2023, employment at newly acquired, established, or expanded foreign-owned businesses in the United States was 110,000 employees."

On July 23, 2024, the BEA announced that "The U.S. direct investment abroad position, or

Credit: JStephanMease, Wikimedia (CC BY-SA 4.0)

cumulative level of investment, increased $364.0 billion to $6.68 trillion at the end of 2023... The increase reflected a $147.1 billion increase in the position in Europe, primarily in Ireland, Switzerland, and the Netherlands."[d]

The Office of the United States Trade Representative is a resource for information about trade agreements, countries and regions, and a slate of trade topics. The International Trade Administration, an agency of the U.S. Department of Commerce, provides support in export solutions, regulations and agreements, and research. In addition, it offers country commercial guides and information about buying from or investing in U.S. businesses.

References

[a]"United States–Geography," CIA World Factbook. https://www.cia.gov/the-world-factbook/countries/united-states/#geography

[b]"United States–Economy," CIA World Factbook. https://www.cia.gov/the-world-factbook/countries/united-states/#economy

[c]"New foreign direct investment in the United States, 2023," Bureau of Economic Analysis. Published 12 July 2024. https://www.bea.gov/news/2024/new-foreign-direct-investment-united-states-2023

[d]"Direct investment by country and industry, 2023," Bureau of Economic Analysis. Published 23 July 2024. https://www.bea.gov/news/2024/direct-investment-country-and-industry-2023

From classroom to commercialization

A conversation with Michel Barsoum, Distinguished Professor of materials science and engineering at Drexel University

On July 3, 2024, Drexel University announced that One-D Nano, a nanomaterial clean technology company, would receive a $150,000 investment from the Drexel University Innovation Fund, which was created to provide start-up capital for the commercialization of innovations and technologies that originated at the school.[4]

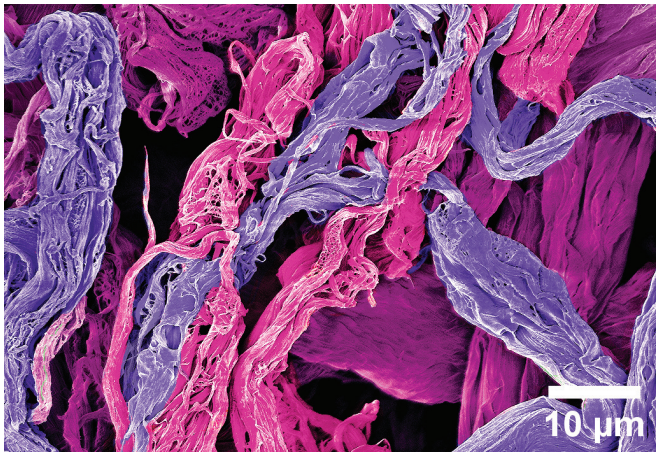
The news follows the discovery in 2022 of one-dimensional nanofilaments by Michel Barsoum, Distinguished Professor in the Department of Materials Science and Engineering, and Hussein Badr, then a doctoral researcher in the Layered Solids Group, which Barsoum leads.

As the July 3 announcement explains, they believe these nanofilaments, which they labeled 1DL, have the capacity to "help sunlight glean hydrogen from water for months at a time to significantly reduce the cost of green hydrogen."

Barsoum is co-founder and technical advisor to One-D Nano, which was launched to commercialize 1DLs with his postdoctoral fellow, Greg Schwenk, who will serve as the company's CEO. Recently, Schwenk was also chosen from a field of more than 1,000 applicants for the prestigious Activate Fellowship,[5] a program with a rich history of cultivating success from hard tech startups spun out of university labs. This award will provide Schwenk with roughly $500,000 over two years that he can use to help build up the company.

But 1DL's potential for environmental impact is just part of the story, in Barsoum's view. He finds it equally exciting that it is a material that can literally be made in a kitchen at minimal cost.

"The combination of using inexpensive starting material, the ease with which we can make the stuff, and the ease with which we can scale it is quite remarkable," he says. "We think we can make it in large quantities, and a lot cheaper than any other nanotech out there. That's the business proposition."



Credit: Scanning electron microscope micrograph taken by G. Schwenk and artistically rendered by Patricia Lyons of Moorestown, N.J.

Scanning electron microscope micrograph showing the morphology of a one-dimensional titania-based material when the water in the colloid suspension is mixed with a solvent.

Michel Barsoum in his lab at Drexel University. He says that many students in recent years demonstrate an entrepreneurial mindset, which he tries to help foster through his research.

Credit: Michel Barsoum

Encouraging and financing entrepreneurs

The Drexel University Innovation Fund recognizes projects with potential for "addressing the world's most pressing challenges," and all returns on investments revert to the fund so they can be awarded to future start-ups.[6] The program also seeks to provide students with hands-on experience in the venture capital arena. That strategy meshes neatly with the entrepreneurial mindset Barsoum sees in many of his students.

"I think this young generation, even at the undergraduate level, sees that as a possibility," he says. "They watch other people become millionaires and billionaires at age 30. That is a pretty strong incentive to start a company and sell it."

He says faculty members are responsible for initiating that innovation, but he also recognizes the importance of institutional and financial backing. Neither form of support was available when he launched start-ups between 10 and 20 years ago, a time that he describes as more ad hoc. Today's approach aligns with his sense of responsibility for preparing the next generation of scientists to take their place in the world as well as his own professional goal to make a difference in meeting global challenges, such as sequestering CO_2 and rendering non-potable water safe to drink.

Acknowledgment and ambition

Barsoum's success in making a difference was recognized on June 18, 2024, at a ceremony that marked his induction as a Fellow of the National Academy of Inventors. He describes that recognition as "the cherry on the cake" but says curiosity and the desire to "solve big problems" have always been his primary motivations.

"Every day I go to work and shake my head. I can't believe they pay me to do this," he says. "I tell my students, 'You know, graduate school is supposed to be fun. If you're not having fun, and I'm serious, let me know because something's wrong.'"

Advances 'for the benefit of the nation'

A conversation with Chris Heckle, director of Argonne National Laboratory's Materials Manufacturing Innovation Center

When your origin story begins with the University of Chicago's work on the Manhattan Project,[7] what do you do for an encore? Argonne National Laboratory's answer is "to make an impact—from the atomic to the human to the global scale...on questions and experiments too large for any one institution to do by itself."

Argonne National Laboratory is one of the 17 U.S. Department of Energy laboratories in the United States. Its 3,400 scientists work on projects with cumulative funding of $1 billion.

In 2022, Argonne formed a new center called the Materials Manufacturing Innovation Center (MMIC). MMIC is but one center within the large national laboratory structure at Argonne, but its focus is manufacturing, particularly in the materials and chemicals processing spaces. Specifically, it serves as the first point of contact between private industry and Argonne's science and research capabilities, all with an eye toward solving complex problems and assisting manufacturers with their clean energy initiatives.

In less than two years, MMIC has made significant progress in connecting Argonne's scientists to industry and building strong collaborations between staff members, contractors, visiting scientists, and successful applicants who request access to the labs. Chris Heckle, director of MMIC, offers the example of university students or corporate researchers or engineers who need access to Argonne's Advanced Photon Source, "which is used to shoot photons, X-rays, and then there can be a lot of characterization in the beam." Access may be offered at no cost if the applicants plan to publish their results; if not, Argonne charges them an amount equal to cost recovery.

An emphasis on functionality over fantasy

Argonne's overarching objectives encompass completion of world-class research, education, problem-solving, and strategic initiatives, but not "cool inventions that never see the light of day," Heckle says.

"They want things to be deployed so that somebody can take advantage of that knowledge for the benefit of the nation," she explains.

Profitability benchmarks do not figure into the equation because while Argonne's commitments span technology invention, development, and scale-up, the lab does not commercialize or market the fruits of its R&D. Rather, it licenses intellectual property, and those licenses can be a source of funding for reinvestment in further exploratory work. But there is no sales component to the lab's activities.

GET INVOLVED WITH MMIC

A list of materials available for licensing from Argonne can be found at https://www.anl.gov/partnerships/materials, and a full list of technologies available for licensing can be found at https://www.anl.gov/partnerships/available-for-licensing. Also on the licensing page, a partnership proposal inquiry form is available, plus guidelines for completing the inquiry.

A nine-minute video available at https://www.youtube.com/watch?v=8CoyU60mEa0 provides information about how the Materials Manufacturing Innovation Center "partners business with science and research."

Supporting national sustainability priorities

In keeping with Department of Energy priorities, teams at Argonne have been pursuing innovations in industrial efficiency and decarbonization, with a focus on certain sectors: chemicals, food and beverage (as an outgrowth of agricultural), pulp and paper, cement and concrete, ceramics, and steel. Initially, glass was not an industry of focus, but that is in the process of changing, and the Department of Energy is now investing more funding in helping the glass industry to decarbonize—for example, by seeking methods of melting glass with the use of renewable fuels.

The emphasis on sustainability extends to more efforts in the area of circularity.

"A huge part of circularity is reuse of waste, such as plastic waste that is upcycled into lubricants and oil. That is one aspect of circularity we're working on," Heckle says. "Another aspect is lithium-ion battery recycling. Cell phone batteries have been dying for years, but car batteries, large volumes of lithium-ion batteries, are going to start to head toward the landfill. What can and should we be doing about that?" Argonne is pursuing the answer to that question in partnership with other national labs, industry, and academia via its ReCell Center.

In October 2023, the Department of Energy's Advanced Materials & Manufacturing Technologies Office announced the allocation of $2 million in funding for "eight projects to drive innovation in lithium-ion battery rejuvenation, recycling, and reuse."[8] The announcement noted, "The ultimate goal is to reduce the environmental impact of battery production while ensuring a reliable and sustainable supply of lithium-ion batteries for electric vehicles, renewable energy storage, and consumer electronics."

Bringing AI/ML into the R&D equation

What impact will artificial intelligence and machine learning have on Argonne's research and development across all its areas of focus?

"The lab is one of a few large supercomputer facilities across the U.S. and the world. Our most recent supercomputer,

which is just coming online and being fully tested, is specifically built for artificial intelligence algorithms," Heckle says.

Another area of focus for AI and machine learning is the Minerals to Materials Supply Chain Facility (METALLIC), which was announced in April 2024 to "establish an innovation ecosystem under a virtual roof that leverages the nation's leading capabilities for accelerating and de-risking critical minerals and materials technology development and commercialization."[9]

The $75 million facility is "designed to support the public and private sector in doing the research, development, demonstration, and deployment needed for a resilient, diverse and secure domestic supply of critical minerals and materials needed for clean energy technologies."

Heckle notes that Senate Majority Leader Chuck Schumer has been pushing a national strategy for artificial intelligence, and one of MMIC's associate lab directors, Rick Stevens, testified on Capitol Hill about artificial intelligence.

"So, we're a thought leader in the use of AI for materials discovery and materials optimization, and we're working to embed AI in a lot of the things we do, such as developing algorithms in conjunction with equipment to be able to achieve particular product targets," Heckle says.

References

[1]"SINTX Technologies to explore strategic opportunities," SINTX Technologies. Published 18 June 2024. Accessed 20 Aug. 2024. https://ir.sintx.com/news-events/press-releases/detail/233/sintx-technologies-to-explore-strategic-opportunities

[2]"SINTX Technologies announces appointment of Eric K. Olson as chief executive officer," SINTX Technologies. Published 6 Aug. 2024. Accessed 20 Aug. 2024. https://ir.sintx.com/news-events/press-releases/detail/234/sintx-technologies-announces-appointment-of-eric-k-olson

[3]D. M. Beall and W. A. Cutler, "Smog begone! How development of ceramic automotive catalytic substrates and filters helped reduce air pollution," *American Ceramic Society Bulletin* 2020, **99**(3): 24–31.

[4]L. Campion, "Drexel materials start-ups receive Innovation Fund investments," Drexel University. Published 3 July 2024. Accessed 20 Aug. 2024. https://drexel.edu/engineering/news-events/news/archive/2024/July/materials-startups-innovation-fund

[5]"Introducing Cohort 2024," Activate. https://www.activate.org/news/introducing-cohort-2024

[6]The Drexel University Innovation Fund, https://drexel.edu/applied-innovation/funding/innovation-fund

[7]"Our history," Argonne National Laboratory. https://www.anl.gov/our-history

[8]"ReCell Center at Argonne awarded $2 million to enhance domestic advancements in lithium-ion battery recycling," Argonne National Laboratory. Published 13 Oct. 2023. Accessed 20 Aug. 2024. https://www.anl.gov/amd/article/recell-center-at-argonne-awarded-2-million-to-enhance-domestic-advancements-in-lithiumion-battery

[9]"Argonne partners with fellow labs to help secure domestic critical material supply chains," Argonne National Laboratory. Published 2 April 2024. Accessed 20 Aug. 2024. https://www.anl.gov/aet/article/argonne-partners-with-fellow-labs-to-help-secure-domestic-critical-material-supply-chains

Fostering visibility and sustainability in glass: An inside look at the Glass Manufacturing Industry Council

The Glass Manufacturing Industry Council (GMIC) describes itself as a "partner, ally, and advocate" that represents the glass sector's interests to governments and trade organizations, sponsors technical programs and other educational initiatives, and supports members with industry intelligence. Its objectives include promoting and facilitating the use of glass and positioning the industry to better meet sustainability demands.

Each year, in partnership with Alfred University and The American Ceramic Society, GMIC organizes the Glass Problems Conference and Symposium. This annual conference provides a platform for leading experts and manufacturers to share information on new innovations and methods to deal with challenges the industry faces with manufacturing glass.

This year's conference tracks—projects, refractory, machine learning, melting and forming, recycling, and decarbonization—reflect the sector's current and emerging concerns. Among the presentation highlights were

- "Improved refractories with excellent glass properties and low carbon footprint," Andrea Kazmierczak, R&D project leader, Saint-Gobain SEFPRO
- "Effect of different bonding phases on the hydration resistance of regenerator checker bricks," Samantha Garnier, research engineer, HarbisonWalker International
- "Use of ML to utilize 3D simulation, field data, or fusion of the two to create digital twins," Vitor Lopes, senior product manager, Ansys Inc.
- "Glass melting fundamentals: Understanding batch reactions, transformations, and moving towards a decarbonized future with a heavy emphasis on recycling," Charmayne Lonergan, assistant professor, Missouri University of Science and Technology
- "Electrification of the glass industry," Caio Barca Bragatto, assistant professor of Physics, Coe College
- "Autonomous AI—Building AI for control and advisory," Chris Conry, group manager, RoviSys
- "Glass recycling: Building infrastructure," Kyle Sword, R&D director of North America, NSG Pilkington
- "Developing a more sustainable glass recycling system," Steve Whettingsteel, CEO and managing director, Krysteline Technologies Ltd.
- "Three European projects for a systemic approach to the decarbonization of glass production," Ernesto Cattaneo, head of R&D, Stara Glass S.p.A.

GMIC also publishes the Glass Manufacturing Industry Report every three years. The next edition of this report, which provides "a comprehensive, up-to-date reference source for intelligence on the glass manufacturing industry," is slated to be published later this year. ■

Directory

ASSOCIATIONS

The American Ceramic Society
The American Ceramic Society (ACerS), based in Westerville, Ohio, is the leading professional membership organization for scientists, engineers, researchers, manufacturers, plant personnel, educators, and students working with ceramics and related materials. To facilitate networking and learning opportunities for its members, the Society oversees the organization of scientific conferences, the publishing of four scholarly journals, an extensive library of in-person and online educational courses, and the production of public-oriented science magazines and blogs, among other resources.

Website: https://ceramics.org

Also within ACerS is the the Ceramic and Glass Industry Foundation (CGIF), which aims to attract, inspire, and support the next generation of ceramic and glass professionals. Since its inception in 2014, the CGIF has launched several programs to achieve its mission, including student and teacher outreach, international student exchanges, travel grants, student leadership development, a university–industry network, and an online Ceramic and Glass Career Center.

Website: https://foundation.ceramics.org

Association of American Ceramic Component Manufacturers
The Association of American Ceramic Component Manufacturers (AACCM), based in Westerville, Ohio, aims to expand the market for manufactured ceramic components by enhancing the processes and product quality of advanced ceramics, as well as by increasing public and industry education and awareness of ceramic applications. Additionally, in recent years, AACCM has worked to create and strengthen relationships and tie-ins with leading U.S. materials science universities to facilitate technology adoption and improve talent recruitment for member companies.

Website: https://aaccm.org

Edward Orton Jr. Ceramic Foundation
The Edward Orton Jr. Ceramic Foundation, based in Westerville, Ohio, works to assist manufacturers with the high-temperature processing of ceramics and other materials. The Foundation has three distinct areas of products and services:

- Pyrometric monitoring devices
- Thermal analytical instruments
- Materials testing services

Website: https://www.ortonceramic.com

Glass Manufacturing Industry Council
The Glass Manufacturing Industry Council (GMIC), based in Westerville, Ohio, is a nonprofit trade association focused on representing the interests of the glass manufacturing industry. In addition to advocating on the industry's behalf with governments and trade organizations, GMIC provides valuable education in the form of technical programs, symposia, and conferences and coordinates technical initiatives.

Website: https://gmic.org

United States Advanced Ceramics Association
The United States Advanced Ceramics Association (USACA), based in Washington, D.C., is the premier association that champions the common business interests of the advanced ceramic producer and end-user industries. USACA functions through working groups led by USACA members. Current active working groups include Ceramic Fiber and CMC Manufacturing, Nuclear Ceramics, Transparent Armor, and Workforce Development.

Website: https://advancedceramics.org

CORPORATIONS

The United States is home to many companies involved in the manufacture and production of advanced ceramic and glass materials, applications, and services. As leaders in their respective niche fields, many of these companies have taken advantage of ACerS Corporate Partnership program to grow their business through networking and exposure to ceramic and glass professionals around the world. View the full list of ACerS Corporate Partners at https://ceramics.org/ceramics.org/corporate-partnership.

GOVERNMENT AGENCIES

DOE national laboratories
An outgrowth of immense investment in scientific research initiated by the U.S. government during World War II, the U.S. Department of Energy's national laboratories have served as the leading institutions for scientific innovation in the United States for more than 70 years. Each of the DOE's 17 national labs have systems in place to collaborate with and provide support to corporate and academic researchers and engineers who are working to resolve complex research and development challenges with an emphasis on translating basic science to innovation. Learn more about the capabilities and programs offered by each lab at https://www.energy.gov/national-laboratories.

DOD laboratories
The U.S. Department of Defense laboratories are comprised of dozens of facilities across 22 states and

Credit: Etkin Celep, Pexels

employ tens of thousands of scientists and engineers, both civilian and military, public employees and contractors. The laboratories engage in activities ranging from basic research through defense system acquisition support to direct operational support of deployed warfighters. Learn more about the activities of each lab at https://defenseinnovationmarketplace.dtic.mil/business-opportunities/laboratories.

UNIVERSITIES*

Alfred University
Offerings: B.S. in both ceramic engineering and glass engineering; M.S. and Ph.D. in both ceramics and glass science
Website: https://www.alfred.edu
Program contact: Gabrielle Gaustad, engineering@alfred.edu

Colorado School of Mines
Offerings: B.S. in ceramic engineering
Website: https://www.mines.edu
Program contact: Savannah Rodgers, savhende@mines.edu

Missouri University of Science and Technology
Offerings: B.S., M.S., and Ph.D. in ceramic engineering
Website: https://www.mst.edu

South Dakota School of Mines and Technology
Offerings: Minor in ceramic engineering
Website: https://www.sdsmt.edu
Program contact: Katrina Donovan, katrina.donovan@sdsmt.edu

**Most materials science and engineering departments at universities across the U.S. have varying levels of ceramic and glass research.* ■

Women in the Department of Defense: Recognizing contributions to our nation

By Randi Swanson

Since the birth of the United States, women have served the country in a multitude of roles.

Traditionally, women supported the nation during wartime through caretaking positions. But women also went out of their way to be more actively involved in combat responsibilities, such as by disguising themselves as men to march to the front lines of battle.[1]

Thanks to changing social norms and new legislation, women today can serve in the armed forces without hiding their identity. As of 2021, women make up about one in five active-duty military personnel and about one in three civilian military personnel.[2,3] Getting to this point, though, has been a bumpy and twisted road.

In 1948, almost three decades after gaining the right to vote, women in the U.S. finally gained the right to serve as permanent members of the armed forces through the Women's Armed Services Integration Act. However, inequalities were written into the law, such as restricting women from serving in combat positions, limiting the number of women who could be officers, and legally establishing that a woman could not command a man.

Besides legal restrictions, women also experienced limited career opportunities in the defense sector due to external economic and societal reasons. For example, women often assume primary care responsibility for children,[4] and they may face sexism in what are supposed to be professional environments.[5]

Despite these barriers, women still pushed to achieve equality. During the Vietnam War, women fought for the right to serve in higher ranking positions, the ability to command units that included men, and to remain in the military while pregnant. Around the turn of the 20th century, women broke through on several fronts, including becoming a fighter pilot and four-star general.[6]

Though today's women have greater autonomy to serve the U.S. in roles of their choosing, they still face persistent and nuanced challenges. For example, people are less likely to pursue certain careers when they do not see others like themselves in that field.[7] This lack of role models can be due to both limited diversity within the sector and not recognizing the contributions of diverse individuals.

The U.S. Department of Defense (DOD) is aware of this underrepresentation and is continually updating its policies to foster a welcoming and equitable environment. For example, in 2022, Congress enacted the FY 2022 National Defense Authorization Act, which guarantees 12 weeks of paid parental leave for service members who bring a child into their family through birth, adoption, or long-term foster care placement.

Professional organizations can also provide the encouragement and support necessary to pursue a career in defense. For example, the ACerS President's Council of Student Advisors (PCSA) has supported the development of many young researchers who have since gone on to work in different institutions and laboratories overseen by the DOD.

The following pages profile seven women who were previously members of the PCSA and now work for the DOD as civilian military personnel. We thank them and all women for their service.

About the author

Randi Swanson is a third-year Ph.D. candidate at the University of California, Davis and Pathways intern at the Air Force Research Laboratory. Contact Swanson at rkswanson@ucdavis.edu.

References

[1]Schulte, B., "Women soldiers fought, bled, and died in the Civil War, then were forgotten," *The Washington Post*. Published 29 April 2013. https://bit.ly/3K5JqeI

[2]"2021 demographics: Profile of the military community," Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy. Published 2021. https://bit.ly/3ywGjJX

[3]"DOD civilian workforce: Actions needed to analyze and eliminate barriers to diversity," U.S. Government Accountability Office. Published June 2023. https://www.gao.gov/assets/gao-23-105284.pdf

[4]King, E. L., et al., "Gender disparities in active-duty Air Force parents' childcare access: Pre-pandemic costs, utilization, and career impacts," *Armed Forces & Society* 2022, **49**(3): 776–797.

[5]Trobaugh, E. M., "Women, regardless: Understanding gender bias in U.S. military integration," National Defense University Press. Published 9 Jan. 2018. https://bit.ly/44M4PmA

[6]DeSimone, D., "Over 200 years of service: The history of women in the U.S. military," United Service Organizations. Published 28 Feb. 2023. https://bit.ly/3QONuUu

[7]Fry, R., et al., "STEM jobs see uneven progress in increasing gender, racial and ethnic diversity," Pew Research Center. Published 1 April 2021. https://bit.ly/3UItjbO ■

ACerS President's Council of Student Advisors

ACerS President's Council of Student Advisors (PCSA) is the student-led committee of ACerS. Its mission is to engage students as active and long-term leaders in the ceramics community and to increase participation in ACerS at the local, national, and international levels. The 2024–25 class of PCSA delegates consists of 53 students from 28 universities, representing 10 countries. The seven women profiled on these pages were previously members of the PCSA and now work for the DOD as civilian military personnel.

Air Force

Lisa M. Rueschhoff

Doctorate in materials engineering, Purdue University

I am a senior materials research engineer in the Materials and Manufacturing Directorate (RX) at the Air Force Research Laboratory (AFRL) in Ohio. My research focus includes additive manufacturing and advanced processing methods for ultrahigh-temperature structural ceramics and composites as well as materials and structures development for morphing aerospace concepts.

I joined the PCSA in 2014 during graduate school at Purdue University, first serving as the Communications Committee chair and then as the 2015–2016 Council chair. My time spent on the PCSA was instrumental in my career to develop important team management and networking skills. Connections I made with fellow PCSA members persist to present-day friendships and collaborations across the world.

I was drawn to working for the DOD due to the connection I felt to the mission and the emphasis made at AFRL/RX to creating a supportive and inclusive workspace. I have been active in the diversity, equity, inclusion, and accessibility initiatives and am a member of resource groups for working moms and dads and women in RX.

Ashley M. Hilmas

Doctorate in materials science and engineering, University of Michigan

I am a materials research engineer in the Materials and Manufacturing Directorate (RX) at the Air Force Research Laboratory (AFRL) in Ohio. My background involves understanding damage evolution in ceramic matrix composites via in situ X-ray computed tomography. At AFRL, I have continued this research and study combined environmental–mechanical effects on structural ceramics for high-temperature applications.

I have been involved with The American Ceramic Society since 2011 when I joined the student organization Material Advantage at Missouri University of Science and Technology (Missouri S&T). While at Missouri S&T, I served as secretary and president of the Missouri S&T Material Advantage Chapter. It was during this time I first engaged in student outreach and volunteering for student summer camps. While in graduate school at the University of Michigan, I continued with my participation in ACerS by joining the PCSA, where I served initially as Finance Committee chair and eventually as the 2017–2018 Council chair.

Throughout my time in the PCSA, I established collaborations and friendships that are thriving to this day. The PCSA allowed me to grow as a leader and launched my enthusiasm for mentorship. I make it a priority to continuously learn and grow as a mentor, and I am passionate about using my role at the DOD to provide opportunities for students across various engineering disciplines.

Katie N. Detwiler

Doctorate in materials science and engineering, University of Virginia

I work as a materials research engineer in the Materials and Manufacturing Directorate at the Air Force Research Laboratory (AFRL) in Ohio. My research focus includes ceramic matrix composites and other high-temperature materials for structural and propulsion applications. I have specialized in evaluating materials in representative environments, analyzing damage modes such as applied mechanical and thermal loads, oxidation, and combined effects.

I joined ACerS as an undergraduate student at Wright State University while interning at AFRL. I continued my membership and joined the PCSA during my Ph.D. studies at the University of Virginia. Serving on the PCSA Outreach Committee allowed me to meet other graduate students and members of the community, which I was especially thankful for as it was during the COVID–19 pandemic.

The friendships and connections that I made through the PCSA have benefited collaborations in my career today at the DOD. I am honored to be a part of the DOD family, working toward a shared mission to support the warfighter.

Army

Victoria L. Blair

Doctorate in ceramics, Alfred University

I am a materials research engineer at the Combat Capabilities Development Command Army Research Laboratory, part of the U.S. Army Futures Command. My research focus is ceramic synthesis and processing, specifically for infrared-transparent ceramics, which could be used as laser gain materials, optical lenses, or windows.

PCSA played a critical role in preparing me for my career by providing me opportunities to develop skills in leadership, program management, and public speaking, including presenting to diverse audiences about deeply technical content. The network I developed through the PCSA brought me to the Army Research Laboratory, and I continue to collaborate closely with other PCSA alumni who now work across the DOD.

When Congress passed the 2022 National Defense Authorization Act, it included a policy that provides 12 weeks of paid leave to service members and civilians who welcome a child into their homes. Since the policy is not gendered or based around the health of the birthing parent, my male colleagues have supported their spouses by taking advantage of the full 12 weeks of leave as well, often spread throughout the year. This equitable approach reduces the overall stigma of taking time off from work for childrearing and is having a positive effect on our workplace culture.

Aubrey L. Fry

Doctorate in materials science and engineering, The Pennsylvania State University

I am a materials research engineer at the Combat Capabilities Development Command Army Research Laboratory. My research spans a variety of ceramic and transparent materials, developing chemistries, fabrication, and post-processing techniques to refine and augment mechanical and optical properties.

My time in the PCSA was rewarding personally and professionally, growing friendships and an invaluable ceramics and glass research network. I particularly enjoyed volunteering for STEM outreach events with the Ceramic and Glass Industry Foundation and being the student delegate to the Glass & Optical Material Division's executive board, which gave me a view into how ACerS functions and flourishes.

Mission mindset is fundamental to my work as a civilian scientist in the DOD Department of the Army, and part of that mission is STEM outreach, which is inexorably linked to diversity. Organizational understanding and mission orientation are critical elements of any team, but teams must also embody diversity, which enables timely and productive scientific invention. The diversity of students and minds that the PCSA brings together and cultivates is a shining example to all organizations.

Navy

Olivia Brandt

Doctorate in materials engineering, Purdue University

I am a materials engineer in the Spacecraft Engineering Division at the Naval Research Laboratory in Washington, D.C. My research focuses on maturing technologies for near-net-shaped fabrication of ceramic matrix composites for space-related applications.

During my years in the PCSA, I served on the Communications and Conference Programming and Competition Committees, was the 2021–2022 PCSA chair, and volunteered with the Ceramic and Glass Industry Foundation at outreach events. The variety of roles and experiences I had in the PCSA provided me with leadership and networking skills along with friends and mentors, which better prepared me to transition into the workforce.

One aspect of working in the DOD I enjoy is the range of technology readiness levels being researched. We can do everything from basic research focusing on novel ideas to flight test ready components and all levels in between.

Lavina Backman

Doctorate in materials science and engineering, University of Virginia

I am the lead materials engineer in the Spacecraft Engineering Division at the Naval Research Laboratory in Washington, D.C. My research focuses on materials for extreme environments, including ultrahigh-temperature ceramics and composites.

While in the PCSA, I served as the Outreach Committee chair in my first year, after which I served on the Communications Committee as well as the Basic Science Division liaison. I credit the PCSA for preparing me as both a scientist and leader. While in the PCSA, I met researchers who eventually became collaborators and lifelong friends. I also learned the value of service and community in the scientific endeavor, a lesson I carry to this day.

I am passionate about pushing the boundaries for what materials can do in extreme environments. The Naval Research Laboratory, being a mission-driven organization that also values scientific innovation and discovery, provides both a purpose and an excellent venue for the exploration of this passion. ■

Jonathon Foreman
ACerS journals managing editor

Recent advances to all-solid-state lithium batteries

Global science and engineering initiatives have brought us ever closer to a world that does not rely on carbon-based power generation. However, the growth of sustainable energy harvesting along with the electrification of transportation have been limited by the lack of efficient and cost-effective energy storage solutions.

Lithium-based batteries are among the leading technologies for energy storage. In lithium batteries, metallic lithium in the anode is converted into lithium ions while simultaneously releasing electrons, which carry the energy to the connected device. The lithium ions travel through the electrolyte to the cathode where they are deposited via reaction with the cathode material and the electrons returning to the battery.

There are many challenges to engineering lithium batteries that maximize the positive interactions among these three layers while minimizing the performance-limiting interactions, as described in the paper "A review on 'Growth mechanisms and optimization strategies for the interface state of solid-state lithium-ion-batteries'" by Liu et al.

For example, regarding the cathode, the most commonly used material is lithium cobalt oxide ($LiCoO_2$). The challenges of cobalt-based cathodes include relatively low energy capacity (theoretically 300 mA·h/g), reactions with electrolytes, potential for thermal runaway, and limited supply.

Of materials being explored to replace cobalt, sulfur has potential for substantially improved cathode capacity, with theoretical values of more than 1,500 mA·h/g. But side reactions in lithium–sulfur batteries limit the availability of sulfur and lithium and lead to capacity fade. In the article "Particle size control of cathode components for high-performance all-solid-state lithium–sulfur batteries," Fan et al. demonstrated high capacity (800–1,000 mA·h/g) with minimal fade when using a nanoscale lithium sulfide/nanoscale sulfide-based electrolyte as a composite cathode.

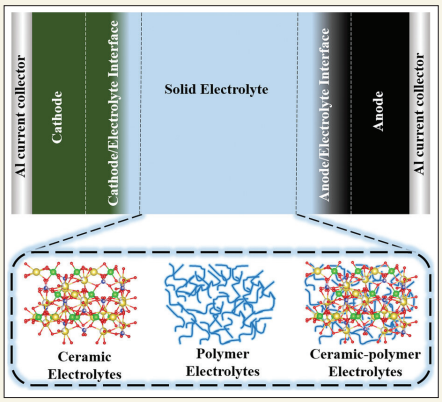
Turning attention to the electrolyte, current lithium-ion batteries employ flammable liquid organic or polymer electrolytes that lack resistance to dendrite formation. In contrast, emerging all-solid-state lithium batteries (ASSLBs) use solid ceramics as the electrolyte (Figure 1), which can resist dendrite formation and mitigate the risk of the battery catching fire.

The three most common classes of ceramic electrolytes used in ASSLBs are lithium aluminum titanium phosphate (LATP), lanthanum zirconium oxide (LLZO), and lithium phosphorus sulfide (LiPS). LATP and LLZO tend to be brittle and are difficult to sinter. LiPS electrolytes are easier to sinter, but they are highly reactive with air and some cathode materials.

Many approaches are being explored for improving ceramic electrolytes. For example, in the articles "An amorphous superionic conductor Li_3PS_4-xLiBr with high conductivity and good air stability by halogen incorporation" by Wang et al. and "Nitrogen doped sulfide solid electrolytes with enhanced air stability and lithium metal compatibility" by Luan et al., they doped LiPS with bromine and nitrogen, respectively, to improve chemical integrity.

In addition, substantial efforts are being made toward improving the anodes of lithium-ion batteries. The most common anode is graphite, which suffers from low capacity (372 mA·h/g) and slow lithium-ion diffusion. Silicon and SiO_x as anode materials offer higher capacities. But these undergo dramatic (100–400%) volume changes during the charge–discharge cycle, which damages the anode–electrolyte interface.

Glass and glass-ceramic anodes provide one avenue for mitigating volume changes. For example, in the paper "Synthesis of passively prelithiated SiO_x nanoparticles for Li-ion battery anode," Kim et al. fabricated lithiated nanoscale SiO_x anodes containing amorphous SiO and various crystalline phases. The anodes exhibited capacities on the order of 1,000 mA·h/g and 75% retention after 50 cycles.



Credit: Vasudevan et al., *International Journal of Applied Ceramic Technology*

Figure 1. Schematic demonstration of a typical all-solid-state sodium battery comprising an anode and cathode integrated with various categories of solid electrolytes.

Some ASSLBs have no anode at all. The so-called anode-less cells are assembled with pre-lithiated cathodes and metal current collectors instead of intercalated anodes. Upon charging, the lithium from the cathode plates directly onto the metal current collector. This method tends to minimize the probability of dendrite formation because no diffusion occurs at the anode.

In the paper "Effect of cell pressure on the electrochemical performance of all-solid-state lithium batteries with zero-excess Li metal anode," Park et al. tested how pressure affects the performance of this type of cell. They found high pressures and/or spring-loading effectively accommodates cathode and anode volume changes with excellent capacity retention up to 97% over 50 cycles.

For more information on the articles in the Topical Collection "Recent advances to all solid-state lithium batteries," please visit https://ceramics.org/publications-resources/journals/sustainability-collections. ■

UPCOMING DATES

HILTON DAYTONA BEACH RESORT AND OCEAN CENTER, DAYTONA BEACH, FLA.

The 49th International Conference & Exposition on Advanced Ceramics & Composites (ICACC 2025) will provide a platform for state-of-the-art presentations and information exchange on cutting-edge ceramic and composite technologies.

HILTON CITY CENTER,
DENVER, CO.

Jointly programmed by the Electronics Division and Basic Science Division, this conference is designed for those interested in electroceramic materials and their applications.

HILTON HYATT REGENCY VANCOUVER,
VANCOUVER, BRITISH COLUMBIA, CANADA

Join us in Vancouver from May 4–9, 2025, for the 16th Pacific Rim Conference on Ceramic and Glass Technology and the Glass & Optical Materials Division Meeting (GOMD 2025).

GREATER COLUMBUS CONVENTION CENTER,
COLUMBUS, OHIO

The Materials Science & Technology (MS&T) technical meeting and exhibition series is a long-standing, recognized forum for fostering technical innovation at the intersection of materials science, engineering, and application. At MS&T, you can learn from those who are on the cutting edge of their disciplines, share your work with the leading minds in your field, and build the valuable cross-disciplinary collaborations unique to this conference series.

Calendar of events

September 2024

16–Dec. 16 ★ Refractory Fundamentals – Virtual; https://ceramics.org/homeny-refractory-fundamentals

October 2024

6–9 ACerS 126th Annual Meeting with Materials Science and Technology 2024 – David L. Lawrence Convention Center, Pittsburgh, Pa.; https://ceramics.org/mst24

15–Nov. 14 ★ Exploring Nanoworlds: Scanning Probe Microscopy and Machine Learning – Virtual; https://ceramics.org/kalinin-probe-microscopy-machine-learning

January 2025

26 ★ Introduction to Thermal Spray Coatings: Science, Engineering, and Applications – Hilton Daytona Beach Oceanfront Resort, Daytona, Fla.; https://ceramics.org/berndt-intro-thermal-spray-coatings

26–31 International Conference and Expo on Advanced Ceramics and Composites (ICACC 2025) – Hilton Daytona Beach Oceanfront Resort, Daytona, Fla.; https://ceramics.org/icacc2025

30–31 ★ Mechanical Properties of Ceramics and Glass 2025 – Hilton Daytona Beach Oceanfront Resort, Daytona, Fla.; https://ceramics.org/quinn-mechanical-properties

February 2025

25–28 EMA 2025: Basic Science and Electronics Division Meeting – Hilton City Center, Denver, Colo.; https://ceramics.org/event/ema-2025-basic-science-and-electronic-materials-meeting

May 2025

4–9 16th Pacific Rim Conference on Ceramic and Glass Technology and the Glass & Optical Materials Division Meeting – Hyatt Regency Vancouver, Vancouver, Canada; https://ceramics.org/pacrim16

July 2025

8–11 ➨ The 8th International Conference on the Characterization and Control of Interfaces for High Quality Advanced Materials (ICCCI 2025) – Highland Resort Hotel & Spa, Fujiyoshida, Japan; https://ceramics.ynu.ac.jp/iccci2025/index.html

September 2025

28–Oct. 1 ACerS 127th Annual Meeting with Materials Science and Technology 2025 – Greater Columbus Convention Center, Columbus, Ohio; https://www.matscitech.org/MST25

January 2026

25–30 International Conference and Expo on Advanced Ceramics and Composites (ICACC 2026) – Hilton Daytona Beach Oceanfront Resort, Daytona, Fla.; https://ceramics.org/icacc2026

May 2026

31–June 5 12th International Conference on High Temperature Ceramic Matrix Composites (HTCMC 12) and Global Forum on Advanced Materials and Technologies for Sustainable Development (GFMAT 2026) – Sheraton San Diego Hotel & Marina, San Diego, Calif.; https://ceramics.org/htcmc12_gfmat2026

August 2026

31–Sept. 1 ➨ The International Conference on Sintering – Aachen, Germany; https://www.sintering2026.org/en

Dates in **RED** denote new event in this issue.

Entries in **BLUE** denote ACerS events.

➨ denotes meetings that ACerS cosponsors, endorses, or otherwise cooperates in organizing.

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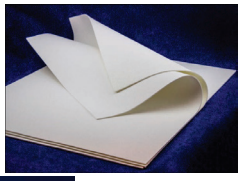

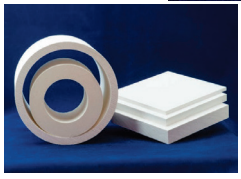

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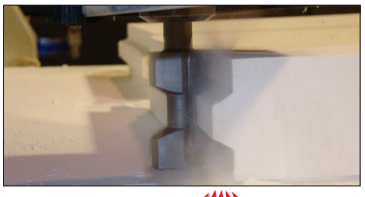

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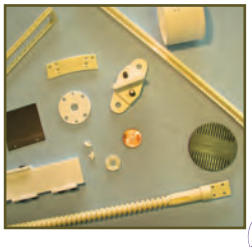

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By Stephanie Castro Baldivieso
Guest columnist

Nuclear waste reduction: Exploring new pathways one step at a time

In my home country of Venezuela, nuclear energy is not a topic that attracts much attention. The government briefly oversaw some nuclear energy programs during the 1950s, but currently there are no active nuclear power facilities in the country. In fact, the Venezuelan government signed and ratified the treaty of the prohibition of nuclear weapons in 2021, which states that Venezuela has never owned, possessed or controlled nuclear weapons or programs of any kind.

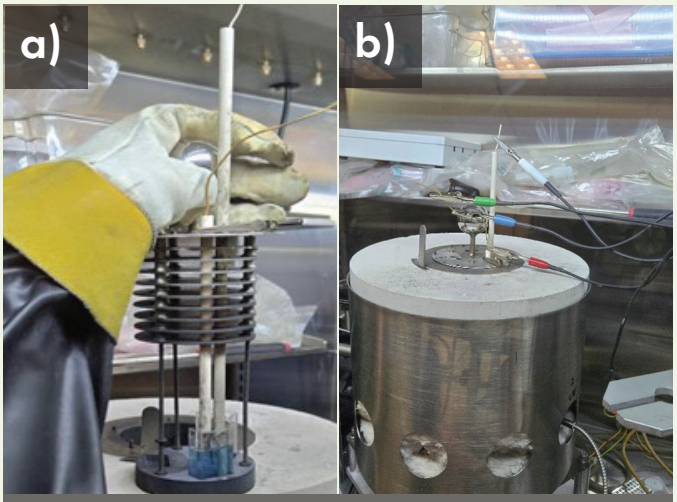
When I moved to the United States, however, nuclear energy became an extremely relevant topic. In the 1940s, the U.S. government established and oversaw the Manhattan Project to build atomic bombs for use in World War II. After the war, the government encouraged scientists to use this information on nuclear reactions to develop nuclear energy for peaceful civilian purposes instead.[1]

During these early days of nuclear research, there were no formal regulatory standards for nuclear waste management. Policies usually were self-regulated and often created based on existing policies of disposal for non-nuclear waste.[2] As a result, there were instances of nuclear waste leaching into the environment and affecting local communities. So, much research has been conducted since then to characterize and store nuclear waste safely and securely.[3]

I first became interested in nuclear energy during my undergraduate studies when I worked on a project involving ligand synthesis to help extract actinides from nuclear waste. I then studied electrochemistry in molten salt systems for nuclear energy applications during my Ph.D.

As I approached graduation, I started looking into national laboratories that have programs involving nuclear energy and waste management. At Idaho National Laboratory (INL), the focus is more on applied processes and how nuclear energy can be innovated to realize next-generation reactor design and technologies. This focus led me to apply for a Seaborg distinguished postdoctoral position at INL, for which I was chosen based on my proposal of a way to improve nuclear waste recycling.

To understand my proposal, we must familiarize ourselves with the makeup of nuclear waste. After uranium dioxide is used as nuclear fuel in a reactor, the fuel matrix is then characterized by various fission products, including rare earth elements, alkali and alkaline earths, and actinides. Some of these fission products can potentially be recovered through pyroprocessing,[4] which involves the electrochemical dissolution of the used nuclear fuel in a molten chloride salt mixture at high temperatures. Though some of the fission products can be easily recovered—for example, uranium is reduced onto an inert cathode by applied potentials—numerous other fission products such as rare earth elements are difficult to recover due to their multivalent oxidation states and side reactions.[5]



Credit: Stephanie Castro Baldivieso

Figure 1. a) Spectroelectrochemical three-electrode cell showcasing a molten chloride salt containing $NdCl_3$ ions. b) Furnace enclosure where the high-temperature experiments take place. Working electrode (tungsten), reference electrode (silver/silver chloride), and counter electrode (tungsten).

To improve the recovery efficiency of rare earth elements specifically, I proposed investigating the fundamental interactions between rare earth elements in the molten chloride salt and their metallic form (Figure 1). The kinetic pathways and the chemical reactions of these elements, which will be elucidated through spectro-electrochemistry at high temperatures, will give insights on how the recovery efficiency can be improved.

Although my research focuses on fundamental science, it will benefit the applied process by generating new scientific knowledge and closing the gap for efficient recycling of the waste: one step at a time.

References

[1]"The history of nuclear energy," U.S. Department of Energy Office of Nuclear Energy, Science, and Technology. https://www.energy.gov/ne/articles/history-nuclear-energy

[2]Fehner, T. R. and Gosling, F.G., "The Manhattan Project: An interactive history," U.S. Department of Energy Office of History and Heritage Resources, July 2005. https://www.osti.gov/opennet/manhattan-project-history/index.htm

[3]"Nuclear waste disposal," U.S. Government Accountability Office, June 2019. https://www.gao.gov/nuclear-waste-disposal

[4]Williamson, M. and Willit, J., "Pyroprocessing flowsheets for recycling used nuclear fuel," *Nuclear Engineering and Technology* 2011, **43**(4): 329–334.

[5]Zhu, H., "Rare earth metal production by molten salt electrolysis," *Encyclopedia of Applied Electrochemistry* 2014, 1765–1772.

Stephanie Castro Baldivieso is the Glenn T. Seaborg Postdoctoral Research Associate at Idaho National Laboratory. Her research focuses on the electrochemical techniques used for lanthanide and actinide separation and electrode characterization. In her free time, Stephanie enjoys fly fishing and being a mentor for the mayfly project in Idaho Falls. ■

WELCOMING NEW FACULTY

Dr. Benjamin Moulton —

Alfred University would like to introduce you to our latest faculty member Dr. Benjamin Moulton has been hired as Assistant Professor of Glass Science. Ben earned a Ph. D. in Earth Sciences at the University of Toronto, Canada after which he spent time at the Center for Research, Technology, and Education in Vitreous Materials (CeRTEV) at the Federal University of São Carlos (UFSCar) in Brazil and then in Materials Science at Friedrich-Alexander Universität Erlangen-Nürnberg (FAU) in Germany. Dr. Moulton's research focuses on the role of structure in all properties, with an emphasis on the mechanical properties and crystallization behavior. Ben is interested in building broad-based models of glass structure that allow for predictive intuitions based on the chemistry of the glass. This goal intersects with understanding the links between mechanics (e.g., toughness, strength), optics (e.g., transparency, refractive index), processing (e.g., the glass transition, viscosity) and thermodynamics (e.g., heat capacity) and structure as well as pragmatic considerations such as environmental impact of source materials and energy demand. In the years ahead, he hopes to explore more exotic compositions, including producing non-traditional oxide glass that require hyper-quenching and fiber draw approaches.

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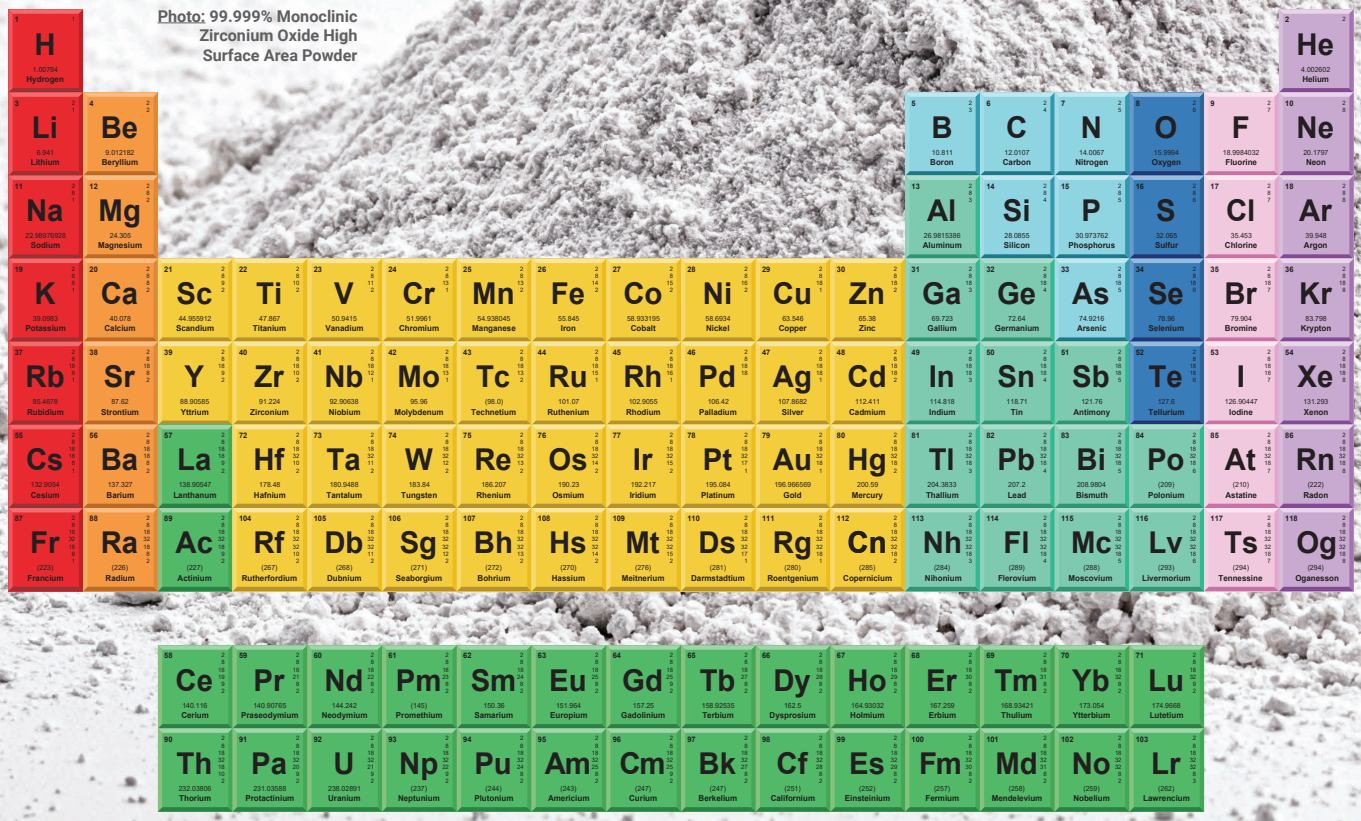

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