

contents

January/February 2020 • Vol. 99 No.1

feature articles



22

Impact of ferroelectricity

Since the discovery of ferroelectricity 100 years ago, ferroelectric materials are everywhere in our electronics-based society. Learn how they drive a \$7 billion industry.

by Susan Trolier-McKinstry



cover story

24

Ferroelectricity—A revolutionary century of discovery

A century after the discovery of ferroelectricity, we look at the physics that makes ferroelectric materials so useful and the research that got us here.

by Geoff Brenneka, Rachel Sherbondy, Robert Schwartz, and Jon Ihlefeld



31

National Science Foundation CAREER Ceramics Program awardees: Class of 2018 and decadal overview

As an independent federal agency of the United States government, the National Science Foundation (NSF) funds basic research conducted at America's colleges and universities. NSF's Ceramics Program in the Division of Materials Research resides within the Mathematical and Physical Sciences Directorate.

by Lynnette D. Madsen

department

News & Trends	3
Spotlight	10
Ceramics in the Environment	16
Research Briefs	17
Advances in Nanomaterials	19
Ceramics in Manufacturing	20

columns

Meet ACerS president Tatsuki Ohji	8
by Eileen De Guire	

Highlights from ACerS 121 st Annual Business Meeting	9
by Lisa McDonald	

Business and Market View	7
Lead-free piezoelectric ceramics market projected to grow at much faster pace through 2024	
by Margareth Gagliardi	

Deciphering the Discipline	48
Ferroelectric nitrides for communications technologies	
by Daniel Drury	

meetings

Glass and Optical Materials Division Annual Meeting (GOMD 2020)	37
6 th Ceramics Expo preview	38
Electronic Materials and Applications (EMA 2020)	40
44 th International Conference and Exposition on Advanced Ceramics and Composites	42

resources

Calendar	44
Classified Advertising	45
Display Ad Index	47

Editorial and Production

Eileen De Guire, Editor
edeguire@ceramics.org
Lisa McDonald, Associate Editor
Michelle Martin, Production Editor
Tess Speakman, Senior Graphic Designer

Editorial Advisory Board

Darryl Butt, University of Utah
Fei Chen, Wuhan University of Technology, China
Michael Cinibulk, Air Force Research Laboratory
Kang Lee, NASA Glenn Research Center
Eliana Muccillo, IPEN-SP, Brazil
Oomman Varghese, University of Houston

Customer Service/Circulation

ph: 866-721-3322 fx: 240-396-5637
customerservice@ceramics.org

Advertising Sales

National Sales

Mona Thiel, National Sales Director
mthiel@ceramics.org
ph: 614-794-5834 fx: 614-794-5822

Europe

Richard Rozelaar
media@alaincharles.com
ph: 44-(0)-20-7834-7676 fx: 44-(0)-20-7973-0076

Executive Staff

Mark Mecklenborg, Executive Director and Publisher
mmecklenborg@ceramics.org

Eileen De Guire, Director of Technical Publications and Communications
edeguire@ceramics.org

Marcus Fish, Development Director
Ceramic and Glass Industry Foundation
mfish@ceramics.org

Michael Johnson, Director of Finance and Operations
mjohnson@ceramics.org

Mark Kibble, Director of Information Technology
mkibble@ceramics.org

Sue LaBute, Human Resources Manager & Exec. Assistant
slabute@ceramics.org

Andrea Ross, Director of Meetings and Marketing
aross@ceramics.org

Kevin Thompson, Director of Membership
kthompson@ceramics.org

Officers

Tatsuki Ohji, President
Dana Goski, President-Elect
Sylvia Johnson, Past President
Stephen Houseman, Treasurer
Mark Mecklenborg, Secretary

Board of Directors

Mario Affatigato, Director 2018-2021
Helen Chan, Director 2019-2022
Monica Ferraris, Director 2019-2022
Kevin Fox, Director 2017-2020
William Headrick, Director 2019-2022
John Kieffer, Director 2018-2021
Sanjay Mathur, Director 2017-2020
Martha McCartney, Director 2017-2020
Jingyang Wang, Director 2018-2021
Stephen Freiman, Parliamentarian



<http://bit.ly/acerstwitter>



<http://bit.ly/acerslink>



<http://bit.ly/acersgplus>



<http://bit.ly/acersfb>



<http://bit.ly/acersrss>

As seen on Ceramic Tech Today...



Credit: ExOne

Government, industry, academia investigate additively manufacturing cemented carbide parts

Additive manufacturing may be an easier way to manufacture cemented carbide parts. The U.S. Army Research Laboratory recently submitted a patent application for a selective laser melting process, and collaborations in industry and academia are investigating binder jetting as well.

Read more at www.ceramics.org/carbideparts

Also see our ACerS journals...

Direct and indirect measurement of large electrocaloric effect in barium strontium titanate ceramics

By G. Dai, S. Wang, G. Huang, et al.
International Journal of Applied Ceramic Technology

Processing and properties of $\text{Bi}_{0.98}\text{R}_{0.02}\text{FeO}_3$ (R = La, Sm, Y) ceramics flash sintered at $\sim 650^\circ\text{C}$ in < 5 s

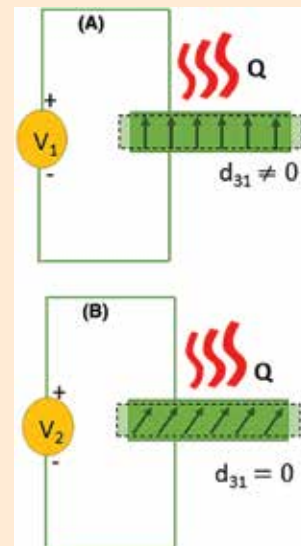
By E. Gil-González, A. Perejón, P. E. Sánchez-Jiménez, et al.
Journal of the American Ceramic Society

Poling tuning: A plausible solution for minimizing microphony and secondary pyroelectric coefficient in ferroelectrics

By R. Kiran, A. Kumar, R. Kumar, and R. Vaisht
International Journal of Applied Ceramic Technology

Dielectric and structural studies of ferroelectric phase evolution in dipole-pair substituted barium titanate ceramics

By V. K. Veerapandiyam, M. Deluca, S. T. Mixture, et al.
Journal of the American Ceramic Society



Read more at www.ceramics.org/journals

American Ceramic Society Bulletin covers news and activities of the Society and its members, includes items of interest to the ceramics community, and provides the most current information concerning all aspects of ceramic technology, including R&D, manufacturing, engineering, and marketing. The American Ceramic Society is not responsible for the accuracy of information in the editorial, articles, and advertising sections of this publication. Readers should independently evaluate the accuracy of any statement in the editorial, articles, and advertising sections of this publication. American Ceramic Society Bulletin (ISSN No. 0002-7812). ©2020. Printed in the United States of America. ACerS Bulletin is published monthly, except for February, July, and November, as a "dual-media" magazine in print and electronic formats (www.ceramics.org). Editorial and Subscription Offices: 550 Polaris Parkway, Suite 510, Westerville, OH 43082-7045. Subscription included with The American Ceramic Society membership. Nonmember print subscription rates, including online access: United States and Canada, 1 year \$135; international, 1 year \$150. * Rates include shipping charges. International Remail Service is standard outside of the United States and Canada. * International nonmembers also may elect to receive an electronic-only, email delivery subscription for \$100. Single issues, January-October/November: member \$6 per issue; nonmember \$15 per issue. December issue (ceramicSOURCE): member \$20, nonmember \$40. Postage/handling for single issues: United States and Canada, \$3 per item; United States and Canada Expedited (UPS 2nd day air), \$8 per item; International Standard, \$6 per item.

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. 99, No. 1, pp 1 - 48. All feature articles are covered in Current Contents.