

contents

August 2019 • Vol. 98 No.6

feature articles



cover story

20

Ceramic materials for 5G wireless communication systems

5G technologies will soon reach the market. Ceramic materials will play an important role in realizing the technology.

by Michael D. Hill and David B. Cruickshank



26

5G—connecting smartphones through ceramics and glass

The nascent 5G network is about more than faster videos and uploads—it holds significant potential for impact on the ceramic and glass materials that are involved in smartphone device design and infrastructure.

by April Gocha



28

Carbon fiber-reinforced carbon composites for aircraft brakes

The demanding requirements of aircraft brake rotor systems require entirely different designs than passenger and sports cars—designs in which carbon fiber-reinforced carbon composites are particularly well-suited.

by R. Gadow and M. Jiménez



35

Annual commodity summary indicates significant impacts due to trade war

USGS Minerals Commodity Summary

by Lisa McDonald

department

News & Trends	3
Spotlight	7
Research Briefs	14
Ceramics in Biomedicine	17
Ceramics in Manufacturing	19

columns

Business and Market View	6
5G chipset market expected to witness tremendous growth over forecast period 2019-2024	
by Sinha G. Gaurav	
Deciphering the Discipline	48
An interdisciplinary venture: Oxidation studies on stressed SiC/SiC CMCs	
by Kaitlin Detwiler	

meetings

Ceramics Expo recap	38
25 th International Congress on Glass (ICG 2019) recap	39
Cements 2019 recap	40
Clay 2019 recap	41
3 rd Annual Energy Harvesting Society Meeting (EHS 2019)	41
Materials Science and Technology (MS&T19)	42

resources

Calendar	44
Classified Advertising	45
Display Ad Index	47

Editorial and Production

Eileen De Guire, Editor
edeguire@ceramics.org

Lisa McDonald, Science Writer

Michelle Martin, Production Editor

Tess Speakman, Senior Graphic Designer

Editorial Advisory Board

Darryl Butt, University of Utah

Michael Cinibulk, Air Force Research Laboratory

Fei Chen, Wuhan University of Technology, China

Thomas Fischer, University of Cologne, Germany

Kang Lee, Chair NASA Glenn Research Center

Chunlei Wan, Tsinghua University, China

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

Sylvia Johnson, President

Tatsuki Ohji, President-Elect

Michael Alexander, Past President

Stephen Houseman, Treasurer

Mark Mecklenborg, Secretary

Board of Directors

Mario Affatigato, Director 2018–2021

Kevin Fox, Director 2017–2020

Dana Goski, Director 2016–2019

John Kieffer, Director 2018–2021

Lynnette Madsen, Director 2016–2019

Sanjay Mathur, Director 2017–2020

Martha McCartney, Director 2017–2020

Gregory Rohrer, Director 2015–2019

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: Pixabay

Chemical map charts course to hundreds of new nitrides

Exploratory synthesis of nitride materials can be a time-consuming and risky venture. A new map of ternary metal nitrides gives scientists a good idea of where to look for new nitrides.

Read more at www.ceramics.org/nitrides

Also see our ACerS journals...

Ternary borosilicates as potential cladding glasses for semiconductor core optical fibers

By I. Dmitrieva, P. Lopez-Isoa, D. Milanese, and L. Petit

International Journal of Applied Glass Science

Crystalline IGZO ceramics (crystalline oxide semiconductor)-based devices for artificial intelligence

By S. Yamazaki, S. Ohshita, M. Oota, et al.

International Journal of Ceramic Engineering and Science

Ultrathin ceramic nanowires for high interface interaction and energy density in PVDF nanocomposites

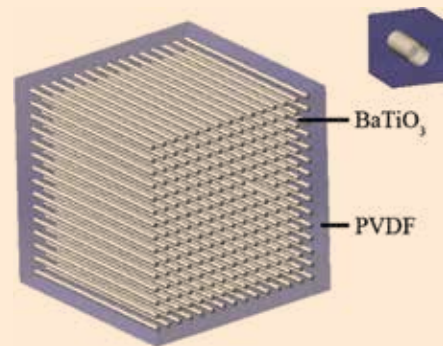
By P. Qu, X. Zhu, X. Peng, et al.

International Journal of Applied Ceramic Technology

Data driven glass/ceramic science research: Insights from the glass and ceramic and data science/informatics communities

By E. De Guire, L. Bartolo, R. Brindle, 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). ©2019. 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. 98, No. 6, pp 1–48. All feature articles are covered in Current Contents.