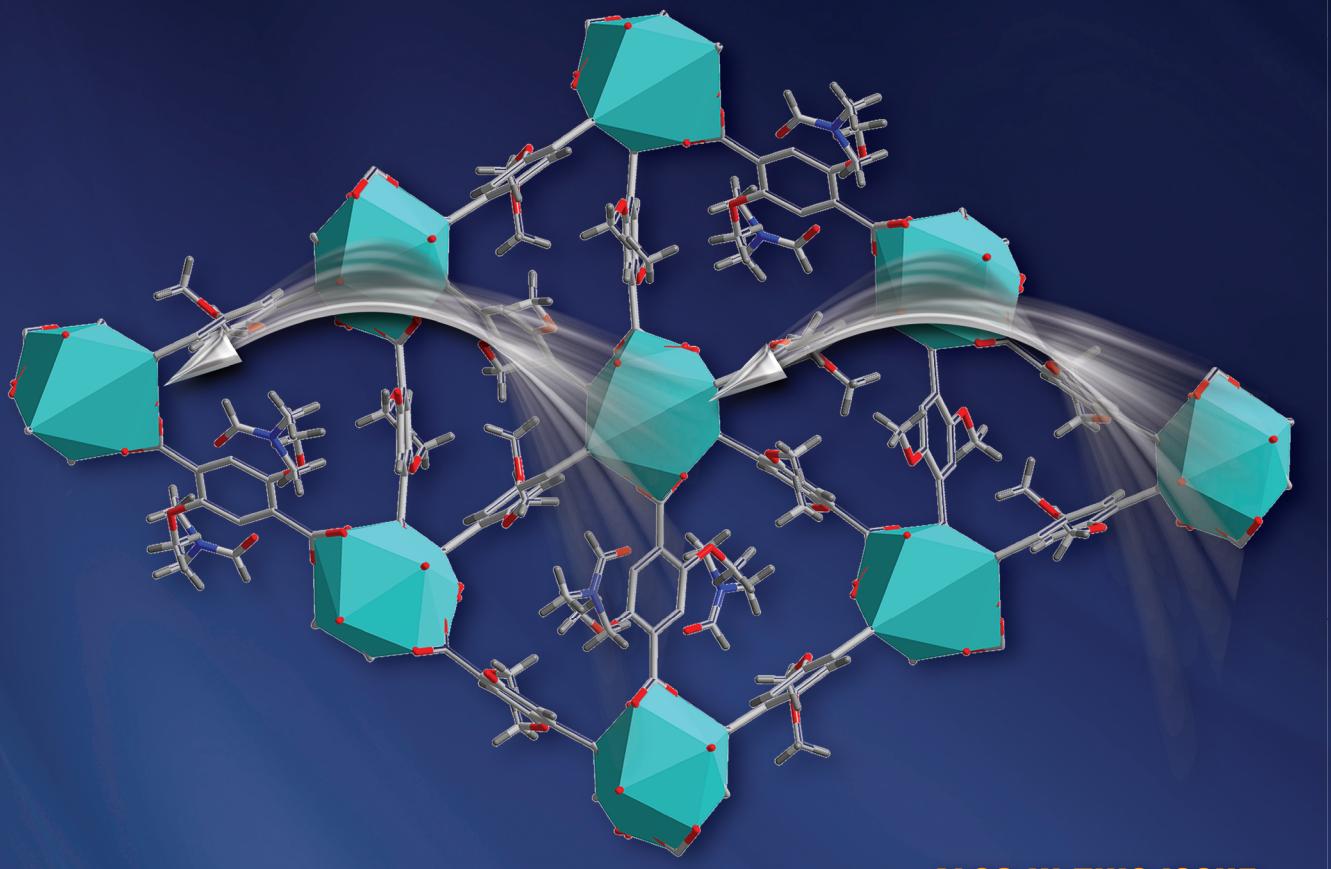


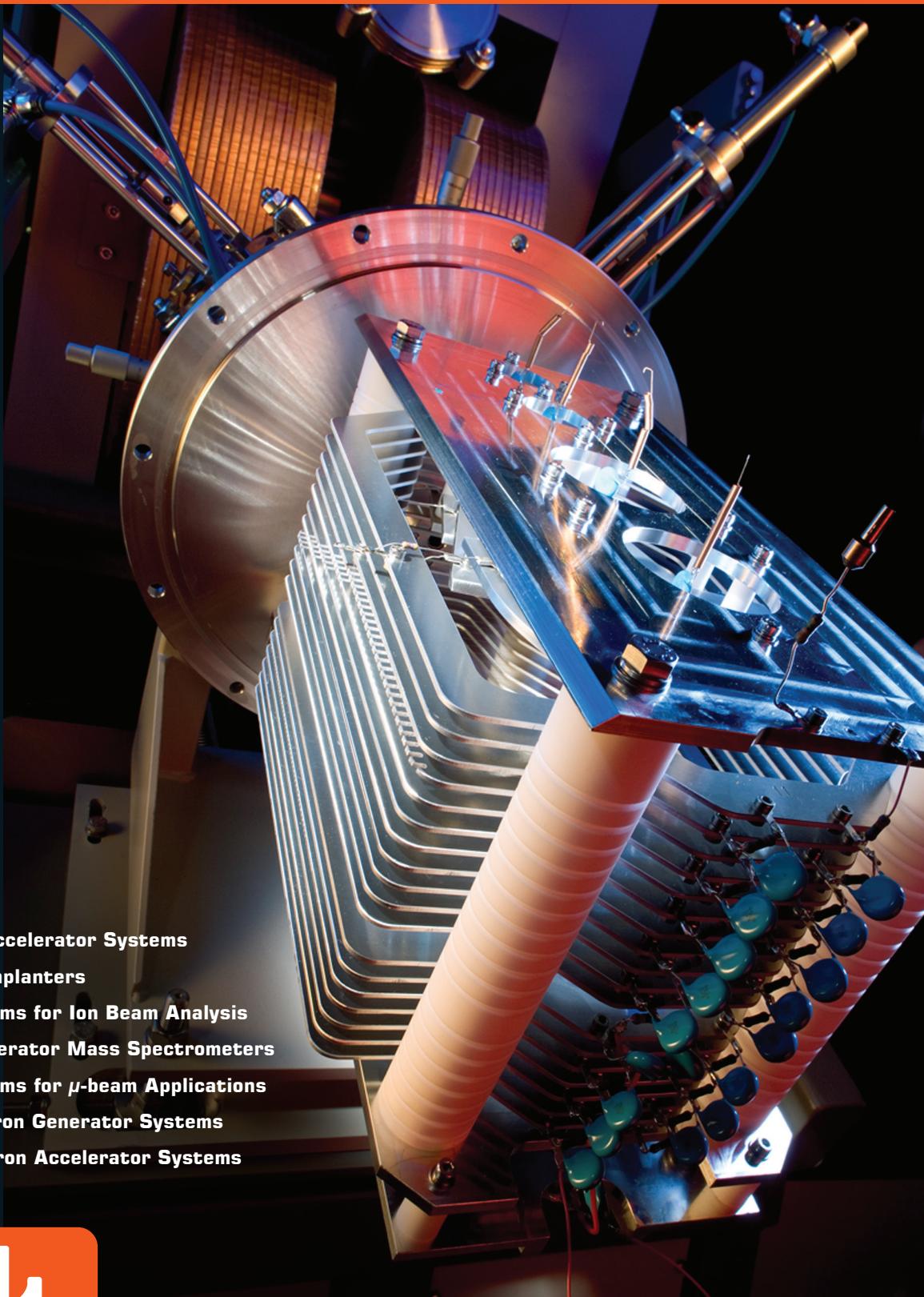
Metal–organic frameworks for electronics and photonics



ALSO IN THIS ISSUE

Skin-inspired organic electronic
materials and devices

PARTICLE ACCELERATOR SYSTEMS



- Ion Accelerator Systems
- Ion Implanters
- Systems for Ion Beam Analysis
- Accelerator Mass Spectrometers
- Systems for μ -beam Applications
- Neutron Generator Systems
- Electron Accelerator Systems



High Voltage Engineering

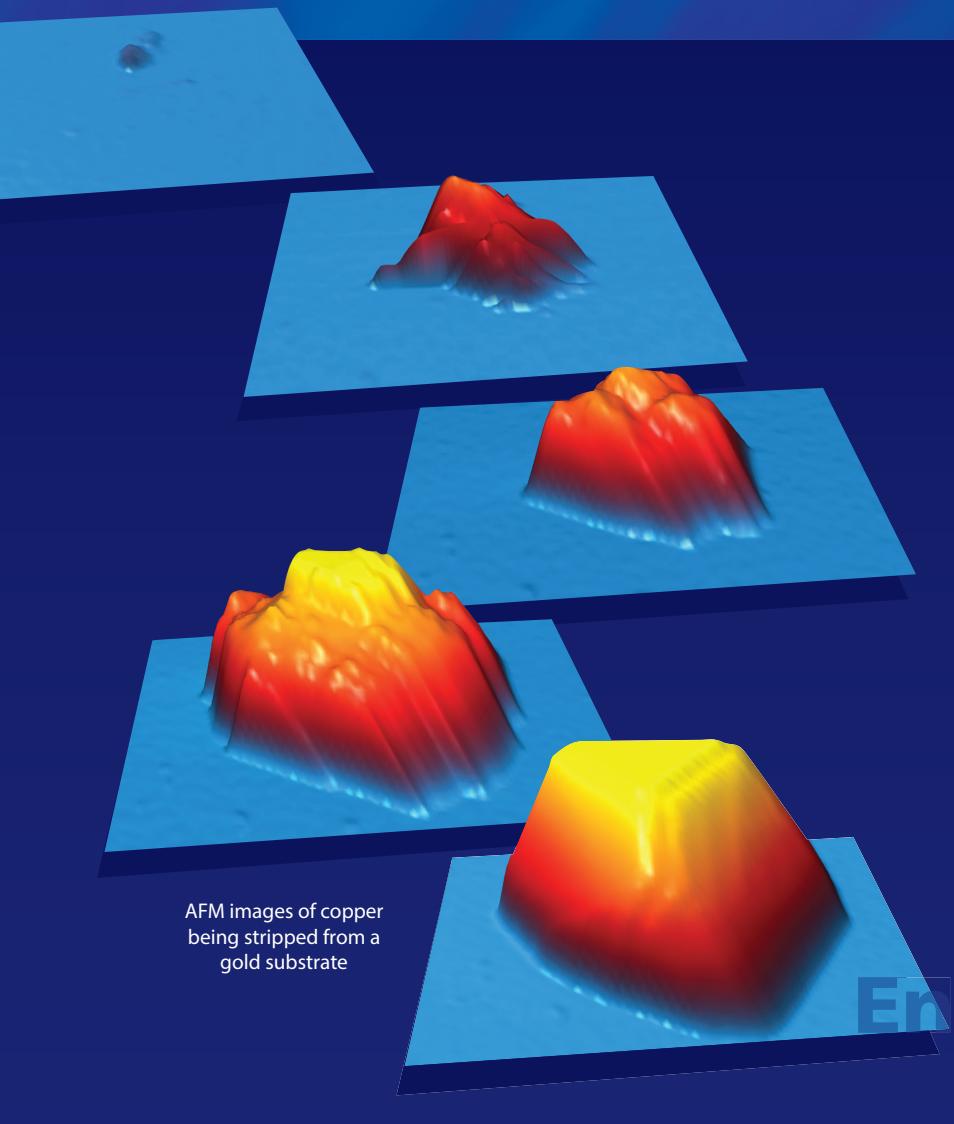
High Voltage Engineering Europa B.V.

P.O. Box 99, 3800 AB Amersfoort, The Netherlands

Tel: 31 33 4619741 • info@highvolteng.com

www.highvolteng.com

The highest resolution, fast scanning AFM for analyzing electrochemical reactions



Cypher AFM — now with electrochemistry capabilities

Highest resolution
fast scanning EC AFM

Compatible with
cutting-edge materials

Hassle-free
environmental control

Glovebox compatible
with no impact on
performance

Electrodeposition
Energy storage
Corrosion

See Cypher in action at MRS booth #510

AFM.info@oxinst.com
(805) 696-6466
www.oxinst.com/AFM

OXFORD
INSTRUMENTS

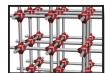
The Business of Science®



MRS Bulletin

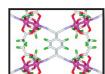
CONTENTS

METAL-ORGANIC FRAMEWORKS FOR ELECTRONICS AND PHOTONICS



854 Metal-organic frameworks for electronics and photonics

Mircea Dincă and François Léonard, Guest Editors



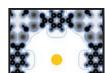
858 Intrinsically conducting metal-organic frameworks

Chanel F. Leong, Pavel M. Usov, and Deanna M. D'Alessandro



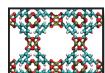
865 Guest molecules as a design element for metal-organic frameworks

Mark D. Allendorf, Raghavender Medishetty, and Roland A. Fischer



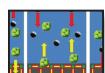
870 Chemical principles for electroactive metal-organic frameworks

Aron Walsh, Keith T. Butler, and Christopher H. Hendon



877 Metal-organic frameworks for thermoelectric energy-conversion applications

A. Alec Talin, Reese E. Jones, and Patrick E. Hopkins



883 Redox-active metal-organic frameworks as electrode materials for batteries

Zhongyue Zhang and Kunio Awaga



890 Metal-organic framework photophysics: Optoelectronic devices, photoswitches, sensors, and photocatalysts

Ekaterina A. Dolgopolova and Natalia B. Shustova

TECHNICAL FEATURE



897 Skin-inspired organic electronic materials and devices

Symposium X (Frontiers of Materials Research) presentation
2015 MRS Fall Meeting

Zhenan Bao

DEPARTMENTS



829 OPINION

Letter from the President
Embracing and celebrating diversity
Kristi S. Anseth



ON THE COVER

Metal-organic frameworks for electronics and photonics. Metal-organic frameworks (MOFs) have outgrown their traditional perception as being only porous molecular sponges to becoming a versatile platform for electronics and photonics applications. The current issue of *MRS Bulletin* highlights the state of the art of the rapidly growing field of MOFs applied to electronics and photonics, far beyond conventional gas storage and gas separation applications. The cover shows an illustration of the structure of a MOF consisting of metal centers connected by organic linkers. Recent developments have led to new designs that enable electronic conduction (arrows) through the framework, opening new avenues for electronics and photonics. See the technical theme that appears on page 854.



NEWS & ANALYSIS

832 Materials News

- **CRISPR: Implications for materials science**
Philip Ball
- **Student-led companies expand the nanotechnology innovation ecosystem**
Michael A. Meador and Lisa E. Friedersdorf
- **Stretchable silver nanowire microelectrodes show promise for studying cell functions**
Kendra Redmond
- **Nanopatterned self-folding origami may open up new possibilities in tissue engineering**
Valentina Naglieri
- **He droplet method produces narrow distributed nanoparticles as stable catalyst**
Xiwen Gong
- **Growth of low-temperature Si nanowires suitable for electronic memory devices**
YuHao Liu

845 Science Policy

- **Policy report on helium proposes long-term solutions**
Jennifer A. Nekuda Malik



SOCIETY NEWS

- 905 ■ **High-entropy alloys: An interview with Jien-Wei Yeh**
N. Balasubramanian
- **Teaching energy and sustainability: The Erice schools**
Antonio Terrasi
- **MRS reports election results for 2017**
- **MRS Bulletin Volume Organizers guide technical theme topics for 2018**

www.mrs.org/bulletinwww.mrs.org/energy-quarterlywww.mrs.org/mymrs<http://journals.cambridge.org>[mrsbulletin-rss](#)[@mrsbulletin](#)

FEATURES

849 Beyond the Lab

- Intel's Carolyn Duran ensures conflict-free minerals supply chain
Prachi Patel

919 Books

- **Batteries for Electric Vehicles: Materials and Electrochemistry**
Helena Berg
Reviewed by N. Balasubramanian
- **Corrosion Protection of Metals by Intrinsically Conducting Polymers**
Pravin P. Deshpande and Dimitra Sazou
Reviewed by K.S.V. Santhanam
- **Material Innovation: Packaging Design**
Andrew H. Dent and Leslie Sherr
Reviewed by Karen Swider Lyons
- **Asphalt Materials Science and Technology**
James G. Speight
Reviewed by Valerio Causin

927 Postermaries

- Fantastic materials
Steve Moss



923 CAREER CENTRAL

ADVERTISERS IN THIS ISSUE

Page No.

* ACS Publications.....	852–853
American Elements.....	Outside back cover
* Asylum Research, an Oxford Instruments Company.....	825
* CRAIC Technologies, Inc.	837
* Goodfellow Corporation.....	843
High Voltage Engineering.....	Inside front cover
* International Centre for Diffraction Data.....	889
* Janis Research Company, LLC.	857
* JEOL USA, Inc.	896
* Kurt J. Lesker Company.....	842
* Lake Shore Cryotronics, Inc.	Inside back cover
* MilliporeSigma (Sigma-Aldrich Materials Science).....	851
Mirwec Film.....	895
Multiwire Laboratories.....	921
* Oxford Instruments	831, 835
* Park Systems Inc.	844
* Princeton Scientific Corp.	917
* Rigaku Corporation.....	876
* Strem Chemicals, Inc.	921
* Thermo-Calc Software Inc.	847
* Wiley.....	903
* J.A. Woollam Company.....	904

* Please visit us at the exhibit, November 29 – December 1, during the 2016 Materials Research Society Fall Meeting in Boston, Mass.

About the Materials Research Society

The Materials Research Society (MRS), a not-for-profit scientific association founded in 1973 and headquartered in Warrendale, Pennsylvania, USA, promotes interdisciplinary materials research. Today, MRS is a growing, vibrant, member-driven organization of over 16,000 materials researchers spanning over 80 countries, from academia, industry, and government, and a recognized leader in the advancement of interdisciplinary materials research.

The Society's interdisciplinary approach differs from that of single-discipline professional societies because it promotes information exchange across many scientific and technical fields touching materials development. MRS conducts three major international annual meetings and also sponsors numerous single-topic scientific meetings. The Society recognizes professional and technical excellence and fosters technical interaction through University Chapters. In the international arena, MRS implements bilateral projects with partner organizations to benefit the worldwide materials community. The Materials Research Society Foundation helps the Society advance its mission by supporting various projects and initiatives.

2016 MRS BOARD OF DIRECTORS

President Kristi S. Anseth, University of Colorado Boulder, USA
Immediate Past President Oliver Kraft, Karlsruhe Institute of Technology, Germany
Vice President and President-Elect Susan Trolier-McKinstry, The Pennsylvania State University, USA
Secretary Sean J. Hearne, Sandia National Laboratories, USA
Treasurer David J. Parrillo, The Dow Chemical Company, USA
Executive Director Todd M. Osman, Materials Research Society, USA

Charles T. Black, Brookhaven National Laboratory, USA
Alexandra Boltasseva, Purdue University, USA
C. Jeffrey Brinker, Sandia National Laboratories and The University of New Mexico, USA
Matt Copel, IBM Research Division, USA
Paul S. Drzaic, Apple, Inc., USA
Yury Gogotsi, Drexel University, USA
Hideo Hosono, Tokyo Institute of Technology, Japan
Young-Chang Joo, Seoul National University, South Korea
Karen L. Kavanagh, Simon Fraser University, Canada
Kornelius Nielsch, IFW Dresden, Germany
Christina Ortiz, Massachusetts Institute of Technology, USA
Sabrina Sartori, University of Oslo, Norway
Magaly Spector, The University of Texas at Dallas, USA
Loucas Tsakalakos, GE Global Research, USA
Anke Weidenkaff, University of Stuttgart, Germany

MRS OPERATING COMMITTEE CHAIRS

Academic Affairs Bruce M. Clemens, Stanford University, USA
Awards Albert Polman, FOM Institute AMOLF, The Netherlands
Government Affairs Kevin Whittlesey, CA Institute for Regenerative Medicine, USA
Meetings David S. Ginley, National Renewable Energy Laboratory, USA
Member Engagement Yves J. Chabal, The University of Texas at Dallas, USA
Public Outreach Elizabeth Kupp, The Pennsylvania State University, USA
Publications Richard A. Vaia, US Air Force Research Laboratory

MRS HEADQUARTERS

Todd M. Osman, Executive Director
J. Ardie Dillen, Director of Finance and Administration
Damon Dozier, Director of Government Affairs
Patricia Hastings, Director of Meetings Activities
Eileen M. Kiley, Director of Communications

Editor

Gopal R. Rao, rao@mrs.org

Managing Editor

Lori A. Wilson, lwilson@mrs.org

News Editor

Judy Meiksin, meiksin@mrs.org

Technical Editor

Lisa C. Oldham, oldham@mrs.org

Editorial Assistants

Michelle S. Raley, raley@mrs.org

Mary Wilmot

Associate Technical Editor

Carol Tseng

Production/Design

Andrea Pekelnicky-Frye, Felicia Turano, Rebecca Yokum, and TNQ

Associate Production Editor

Niki Rokicki

Principal Development Editor

Elizabeth L. Fleischer

Director of Communications

Eileen M. Kiley

Guest Editors

Mircea Dincă and François Léonard

Special Consultant

Angelika Veziridis

Energy Quarterly

George Crabtree (Co-Chair), Elizabeth A. Kócs (Co-Chair), Andrea Ambrosini, Monika Backhaus, David Cahen, Russell R. Chianelli, Shirley Meng, Sabrina Sartori, Anke Weidenkaff, M. Stanley Whittingham, and Steve M. Yalisove

Advertising/Sponsorship

Mary E. Kaufold, kaufold@mrs.org
Donna L. Watterson, watterson@mrs.org

Member Subscriptions

Michelle Judt, judt@mrs.org

Non-Member Subscriptions

subscriptions_newyork@cambridge.org

EDITORIAL BOARD

Fiona C. Meldrum (Chair), University of Leeds, UK
V.S. Arunachalam, Center for Study of Science, Technology & Policy, India
Christopher Bettinger, Carnegie Mellon University, USA
Paul S. Drzaic, Apple, Inc., USA
Igor Lubomirsky, Weizmann Institute, Israel
Amit Misra, University of Michigan, USA
Steven C. Moss, The Aerospace Corporation, USA
Julie A. Nucci, Cornell University, USA
Linda J. Olafsen, Baylor University, USA
James W. Stasiak, HP Inc., USA
Carol Trager-Cowan, University of Strathclyde, UK
Anke Weidenkaff, University of Stuttgart, Germany
Eric Werwa, Washington, DC, USA
M. Stanley Whittingham, Binghamton University, The State University of New York, USA
Steve M. Yalisove, University of Michigan, USA

VOLUME ORGANIZERS

2016 Ilke Arslan, Pacific Northwest National Laboratory, USA
Rick Barto, Lockheed Martin Advanced Technology Laboratories, USA
Boaz Pokroy, Technion-Israel Institute of Technology, Israel
Zhiwei Shan, Xi'an Jiaotong University, China

2017 Ken Haenen, Hasselt University & IMEC vzw, Belgium
John C. Mauro, Corning Incorporated, USA
Michael S. Strano, Massachusetts Institute of Technology, USA
Joyce Y. Wong, Boston University, USA

2018 Karsten Albe, Technische Universität Darmstadt, Germany
Hiroshi Funakubo, Tokyo Institute of Technology, Japan
Michael Hickner, The Pennsylvania State University, USA
Bethanie Stadler, University of Minnesota, USA

MRS Bulletin (ISSN: 0883-7694, print; ISSN 1938-1425, online) is published monthly by the Materials Research Society, 506 Keystone Drive, Warrendale, PA 15086-7573. Copyright © 2016 Materials Research Society. Permission required to reproduce content. Periodical postage paid at New York, NY, and at additional mailing offices. POSTMASTER: Send address changes to *MRS Bulletin* in care of the Journals Department, Cambridge University Press, 100 Brook Hill Drive, West Nyack, NY 10594-2113, USA. Printed in the U.S.A.

Membership in MRS is \$125 annually for regular members, \$30 for students. Dues include an allocation of \$29 for a subscription to *MRS Bulletin*. Individual member subscriptions are for personal use only. Non-member subscription rates are \$483 for one calendar year (12 issues) within North America and \$580 elsewhere. Requests from subscribers for missing journal issues will be honored without charge only if received within six months of the issue's actual date of publication.

MRS Bulletin is included in Current Contents/Engineering, Computing, and Technology; Current Contents/Physical, Chemical, and Earth Sciences, the SciSearch® online database, Research Alert®, Science Citation Index®, and the Materials Science Citation Index™. Back volumes of *MRS Bulletin* are available on microfiche through University Microfilms Inc., 300 North Zeeb Road, Ann Arbor, MI 48106, USA.

Authors of each technical article appearing in *MRS Bulletin* are solely responsible for all content in their article(s), including accuracy of the facts, statements, and citing resources. Facts and opinions are solely the personal statements of the respective authors and do not necessarily represent the views of the editors, the Materials Research Society, or Cambridge University Press.

Send Letters to the Editor to Bulletin@mrs.org. Include your name, affiliation, and full contact information.