## About the Materials Research Society

The Materials Research Society (MRS), a not-forprofit scientific association founded in 1973, promotes interdisciplinary goal-oriented basic research on materials of technological importance. Membership in the Society includes over 13,400 scientists, engineers, and research managers from industrial, government, and university research laboratories in the United States and close to 70 countries.

The Society's interdisciplinary approach differs from that of single-discipline professional societies because it promotes information exchange across the many technical fields touching materials development. MRS sponsors two major international annual meetings encompassing approximately 70 topical symposia, and also sponsors numerous single-topic scientific meetings. The Society recognizes professional and technical excellence and fosters technical interaction in local geographic regions through Sections and University Chapters.

MRS participates in the international arena of materials research through the International Union of Materials Research Societies (IUMRS). MRS is a member of ASTRA and is an affiliate of the American Institute of Physics.

MRS publishes symposium proceedings, MRS Bulletin, Journal of Materials Research, and other publications related to current research activities.

MRS Bulletin (ISSN: 0883-7694) is published 12 times a year by the Materials Research Society, 506 Keystone Drive, Warrendale, PA 15086-7573. Copyright ©2006, Materials Research Society. Permission required to reproduce content. Periodical postage paid at Warrendale, PA, and at additional mailing offices. POSTMASTER: Send address changes to MRS Bulletin in care of the Materials Research Society, at the address listed; tel. 724-779-3003; fax 724-779-8313. Printed in the U.S.A.

Membership in MRS is \$105 annually for regular members, \$30 for students. Dues include an allocation of \$29 (\$17 for students) to a subscription to MRS Bulletin. Individual member subscriptions are for personal use only. Non-member subscription rates are \$230 for one calendar year (12 issues) within the U.S.A. and \$285 elsewhere. Single copies may be purchased for \$35 each. 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; otherwise, the issue may be purchased at the single-copy price.

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.

Send Letters to the Editor to:

MRS Bulletin
Materials Research Society
506 Keystone Drive
Warrendale, PA 15086-7573 USA
Fax 724-779-8313
Bulletin@mrs.org

Letters must include your name, affiliation, and full contact information.

## MRIS BULLETIN

Editorial Office • 506 Keystone Drive • Warrendale, PA 15086-7573 USA Tel. 724-779-3004 ext. 522; fax 724-779-8313; Bulletin@mrs.org; http://www.mrs.org/

**Editor** 

E.L. Fleischer

**Managing Editor** 

J. Meiksin

**Technical Editor** 

A. Bertram Wilson

Editorial Assistants

B. Moriarty and K.D. Wilson

Art Director E. Stiller

Design/Production

S. Franklin and D. Miller

Advertising

M.E. Kaufold and D.L. Watterson

Circulation

S. Forrest

**Guest Editors** 

J.R. Rodgers and D. Cebon

Special Contributors

J.T. Abiade, J.J. Carvajal, C. Henager, C. McCormick, O. Moloye, S. Trohalaki, D. Uskokovic, and S.G. Yeates

Special Consultants

Y. Ballim, M.I. Baraton, G.M. Chow, R.L. Fleischer, and R. Ford

**Associate Technical Editor** 

T. Palucka

**Book Review Board** 

J.H. Westbrook (Chair), C. Batich, R.J. Matyi, L. Olafsen, S. Sant, and J.-C. Zhao

**Visiting Scientist** 

V.S. Arunachalam Center for Study of Science, Technology & Policy Bangalore, India

MRS Office of Public Affairs

499 South Capitol Street SW, Suite 600

Washington, DC 20003

**EDITORIAL BOARD** 

P.S. Drzaic, Chair Alien Technology Corp. Morgan Hill, CA

V.S. Arunachalam Center for Study of Science, Technology & Policy Bangalore, India

I.W. Boyd University College London London, UK

R.C. Cammarata Johns Hopkins University Baltimore, MD Laura Fornaro University of Uruguay Montevideo, Uruguay

A.L. Greer University of Cambridge Cambridge, UK

G.G. Long Argonne National Laboratory Argonne, IL

S.C. Moss Aerospace Corporation Los Angeles, CA J.R. Weertman Northwestern University Evanston, IL

E. Werwa Washington, DC

J.H. Westbrook Brookline Technologies Ballston Spa, NY

S.M. Yalisove University of Michigan Ann Arbor, MI

**VOLUME ORGANIZERS** 

2005

S.A. Carter University of California, Santa Cruz

M.E. Davis California Institute of Technology

T.P. Russell University of Massachusetts **2006** P.A. M

P.A. Midgley University of Cambridge, UK

C.A. Orme Lawrence Livermore National Laboratory

J.A. Rogers University of Illinois at Urbana-Champaign

J.-C. Zhao GE Global Research Center 2007

T.F. Kuech University of Wisconsin–Madison

T.E. Mallouk Pennsylvania State University

J.A. Nucci Max Planck Institute for Metals Research, Germany

R.A. Register Princeton University 2008

Y.-T. Cheng General Motors R&D Center

R.S. Goldman University of Michigan

R. Krishnamoorti University of Houston

A. Sellinger Institute of Materials Research and Engineering, Singapore

## **2006 MRS OFFICERS**

President

P.F. Green University of Michigan

Vice President and President-Elect A.J. Hurd

A.J. Hurd Los Alamos National Laboratory Secretary C.A. Volkert

Forschungszentrum Karlsruhe

Immediate Past President D.J. Eaglesham Applied Materials Executive Director
Materials Research Society
J. B. Ballance

## **INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES**

President
L. Zhou G.M. Crean
NIN Tyndall Natl. Inst.
Xian, Shaanxi, China Cork, Ireland

Second Vice President B.V.R. Chowdari National University of Singapore Singapore **Secretary** G. Zhang BIAM Beijing, China Treasurer H. Yamamoto Nihon Univ. Chiba, Japan Immediate Past President R.J. Nemanich North Carolina State Univ. Raleigh, NC, USA General Secretary R.P.H. Chang Northwestern University Evanston, IL, USA

**IUMRS ADHERING BODIES** 

Australian Materials Research Society (A-MRS) J.S. Williams, Australian National University Brazil Materials Research Society (B-MRS) E. Longo. UFSCar

Chinese Materials Research Society (C-MRS)
L. Zhou, NW Institute for Nonferrous Metal Research

European Materials Research Society (E-MRS) H. Grimmeiss, University of Lund Materials Research Society (MRS) P.F. Green, University of Michigan Materials Research Society of Argentina (MRS-Argentina) J. Ovejero García, CNEA

Materials Research Society of India (MRS-I) R.A. Mashelkar, Council of Scientific & Industrial Research

Materials Research Society of Japan (MRS-J) O. Takai, Nagoya University Materials Research Society of Korea (MRS-K)

J.-W. Park, Hanyang University
Materials Research Society of Russia (MRS-Russia)
N.Z. Lyakhov, Russian Academy of Sciences

Materials Research Society of Singapore (MRS-S) B.V.R. Chowdari, National University of Singapore

Materials Research Society of Taiwan (MRS-T) J.-M. Liu, ITRI

Mexican Materials Research Society (Mexican-MRS) P.H. Hernández Tejeda, Benemérita Universidad Autónoma de Puebla