

A Publication of the Materials Research Society

Volume 21, Number 8 ISSN: 0883-7694 CODEN: MRSBEA

## **PLASMA PROCESSING OF ADVANCED MATERIALS**

- 26 Plasma Processing of Advanced Materials**  
G. Collins and D.J. Rej,  
Guest Editors
- 32 Plasma Generation for Materials Processing**  
M.A. Lieberman, G.S. Selwyn,  
and M. Tuszewski
- 38 Use of Plasma Processing in Making Integrated Circuits and Flat-Panel Displays**  
R.A. Gottscho, M.E. Barone,  
and J.M. Cook
- 43 Modification of Polymeric Surfaces With Plasmas**  
D.M. Coates and S.L. Kaplan
- 46 Plasma Surface Engineering of Metals**  
K-T. Rie, E. Menthe, A. Matthews,  
K. Legg, and J. Chin
- 52 Plasma-Immersion Ion Implantation**  
J.V. Mantese, I.G. Brown,  
N.W. Cheung, and G.A. Collins
- 58 Intense Ion-Beam Treatment of Materials**  
H.A. Davis, G. E. Remnev,  
R.W. Stinnett, and K. Yatsui
- 65 Materials Processing With Thermal Plasmas**  
M. Boulos and E. Pfender

## **TECHNICAL FEATURE**

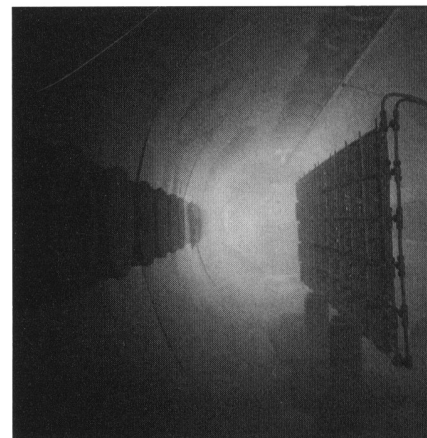
- 16 From Gibbsian Thermodynamics to Electronic Structure: Nonempirical Studies of Alloy Phase Equilibria**  
D. de Fontaine

## **JMR ABSTRACTS**

- 72 Abstracts for October 1996**  
*Journal of Materials Research*

## **DEPARTMENTS**

- 4 Letters to the Editor**
- 5 Research/Researchers**
- 10 Resources**
- 12 Washington News**
- 13 Public Affairs Forum**
- 15 Editor's Choice**
- 62 Advertisers in This Issue**
- 70 Historical Note**
- 71 Library**
- 79 Classified**



**ON THE COVER:** A rack of 90 aluminum automotive pistons being treated by plasma-immersion ion implantation, a process invented at the University of Wisconsin and being developed for automotive applications by the university with General Motors Research and Los Alamos National Laboratory. As discussed in the article beginning on p. 52 by Joseph Mantese and others, the implantation process is one of several plasma-based materials-processing steps to improve piston wear properties. The blue glow is the characteristic emission spectra from oxygen and argon gases ionized inside the vacuum chamber by radio-frequency electric fields (generated by the antenna positioned near the top of the chamber). The pistons are mounted atop ceramic insulators and are energized by a pulsed electric power supply, accelerating ions from the plasma into exposed piston surfaces. (Photograph courtesy of Los Alamos National Laboratory.)

## About the Materials Research Society

The Materials Research Society (MRS), a non-profit scientific association founded in 1973, promotes interdisciplinary goal-oriented basic research on materials of technological importance. Membership in the Society includes over 12,000 scientists, engineers, and research managers from industrial, government, and university research laboratories in the United States and nearly 50 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 60 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 the Federation of Materials Societies 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, 9800 McKnight Road, Pittsburgh, PA 15237. Application to mail at second class rates has been approved at Pittsburgh, PA and at additional mailing offices. POSTMASTER: Send address changes to *MRS Bulletin* in care of the Materials Research Society, at the address listed; phone (412) 367-3003; fax (412) 367-4373. Printed in the U.S.A.

Additional copies of articles in *MRS Bulletin* may be made at \$2.50 per article. This fee can be paid to the Materials Research Society through the Copyright Clearance Center, Inc., 27 Congress Street, Salem, MA 01970.

Membership in MRS is \$75 annually for regular members, \$25 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 \$135 for one calendar year (12 issues) within the U.S.A. and \$185 elsewhere. Single copies may be purchased for \$16 each. Send subscription orders to Subscription Department, Materials Research Society, 9800 McKnight Road, Pittsburgh, PA 15237.

*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 in 16mm microfilm, 35mm microfilm, or 105mm microfiche through University Microfilms Inc., 300 North Zeeb Road, Ann Arbor, Michigan 48106.

**Materials Research Society**  
9800 McKnight Road  
Pittsburgh, PA 15237-6006  
Tel. (412) 367-3003; Fax (412) 367-4373  
<http://www.mrs.org/>

# MRS BULLETIN

Editorial Office • 9800 McKnight Road • Pittsburgh, PA 15237-6006  
Tel. (412) 367-3004 x522; fax (412) 367-4373; <http://www.mrs.org/>

**Editor**  
E.L. Fleischer

**Managing Editor**  
J. Meiksin

**Assistant Editor**  
L.R. Gallagher

**Art Director**  
C. Love

**Design/Production**  
T. Aiello and S. Franklin

**Editorial Assistants**  
M.S. Cheng, J. Dininny, and  
M. Wilmoth

**Advertising**  
M.E. Kaufold

**Circulation**  
S.E. Krasa

**Guest Editors**  
G. Collins and D.J. Rej

**Special Contributors**  
J.R. Abelson, M. Schlessinger,  
R.L.B. Selinger, and  
L.A. Snyder

**Special Consultant**  
M. Goodway

**Associate Editor—Europe**

I.W. Boyd  
University College London  
Dept. of Electronic and  
Electrical Engineering  
Torrington Place  
London WC1E 7JE, U.K.  
Tel. 44-171-380-7300 or 7302

**Book Review Editor**  
C.J. McHargue  
University of Tennessee  
Knoxville, Tennessee

**MRS Office of Public Affairs**  
555 13th Street NW, Suite 900 East  
Washington, DC 20004  
Tel. (202) 383-8809, Fax (202) 383-8877

### CHAIR—EDITORIAL BOARDS

E.N. Kaufmann • Argonne National Laboratory • Argonne, Illinois, USA

### INTERNATIONAL ADVISORY BOARD

M. Balkanski  
University of Pierre and Marie Curie  
Paris, France

R.G. Elliman  
Australian National University  
Canberra, Australia

S. Hsu  
Chung Shan Institute of Science  
and Technology, Retired  
Taiwan, China

L.C. Ianniello  
U.S. Department of Energy, Retired  
Washington, DC, USA

H-D. Li  
National Science Foundation-China  
Beijing, China

P. Rama Rao  
Ministry of Science and Technology  
New Delhi, India

R. Roy  
The Pennsylvania State University  
University Park, Pennsylvania, USA

T. Sugano  
Toyo University  
Tokyo, Japan

### TECHNICAL EDITORIAL BOARD

J.C. Bravman  
Stanford University  
Stanford, California, USA

C.W. Draper  
AT&T Engineering Research Center  
Princeton, New Jersey, USA

E. Fogarassy  
Centre de Recherches Nucléaires  
Strasbourg, France

F.Y. Fradin  
Argonne National Laboratory  
Argonne, Illinois, USA

B.M. León  
Universidad de Vigo  
Vigo, Spain

G.L. Liedl  
Purdue University  
West Lafayette, Indiana, USA

S. Namba  
Nagasaki Institute of Applied Science  
Tokyo, Japan

A.D. Romig Jr.  
Sandia National Laboratories  
Albuquerque, New Mexico, USA

J. Soares  
Universidade de Lisboa  
Lisboa, Portugal

K.C. Taylor  
General Motors R&D Center  
Warren, Michigan, USA

### MRS BULLETIN PUBLICATIONS SUBCOMMITTEE

M. Nastasi, Chair  
Los Alamos National Laboratory  
Los Alamos, New Mexico

R.C. Ewing  
University of New Mexico  
Albuquerque, New Mexico

R.L. Fleischer  
Rensselaer Polytechnic Institute  
Troy, New York

A.J. Hurd  
Sandia National Laboratories  
Albuquerque, New Mexico

M. Libera  
Stevens Institute of Technology  
Hoboken, New Jersey

F. Shapiro  
Drexel University  
Philadelphia, Pennsylvania

C.W. White  
Oak Ridge National Laboratory  
Oak Ridge, Tennessee

### 1996 MRS EXECUTIVE COMMITTEE

**President**  
C.V. Thompson  
Massachusetts Institute of Technology

**First Vice President and President-Elect**  
R. Hull  
University of Virginia

**Second Vice President and  
Vice President-Elect**  
R.J. Nemanich  
North Carolina State University

**Secretary**  
K.S. Jones  
University of Florida

**Treasurer**  
A.K. Hays  
Sandia National Laboratories

**Immediate Past President**  
J.M. Phillips  
Sandia National Laboratories

**Councillors**  
R. Gibala  
University of Michigan

A.I. Taub  
Ford Research Laboratory

**Executive Director  
Materials Research Society**  
John B. Ballance

### INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES

**President**  
M. Doyama  
Nishi-Tokyo University  
Tokyo, Japan

**Vice President**  
R.C. Ewing  
University of New Mexico  
Albuquerque, New Mexico  
USA

**Secretary**  
G-C. Chi  
National Central University  
Chung-Li, Taiwan

**Treasurer**  
G.M. Crean  
University College  
Cort, Ireland

**Immediate Past President**  
P. Siffert  
Centre de Recherches Nucléaires  
Strasbourg, France

**General Secretary**  
R.P.H. Chang  
Northwestern University  
Evanston, Illinois  
USA

### IUMRS ADHERING BODIES

Australian Materials Research Society (A-MRS)  
J.S. Williams, Australian National University

Chinese Materials Research Society (C-MRS)  
H-D. Li, Tsinghua University

European Materials Research Society (E-MRS)  
I.W. Boyd, University College London, UK

Materials Research Society (MRS)

Materials Research Society of India (MRS-I)  
S.K. Joshi, JNCASR, New Delhi

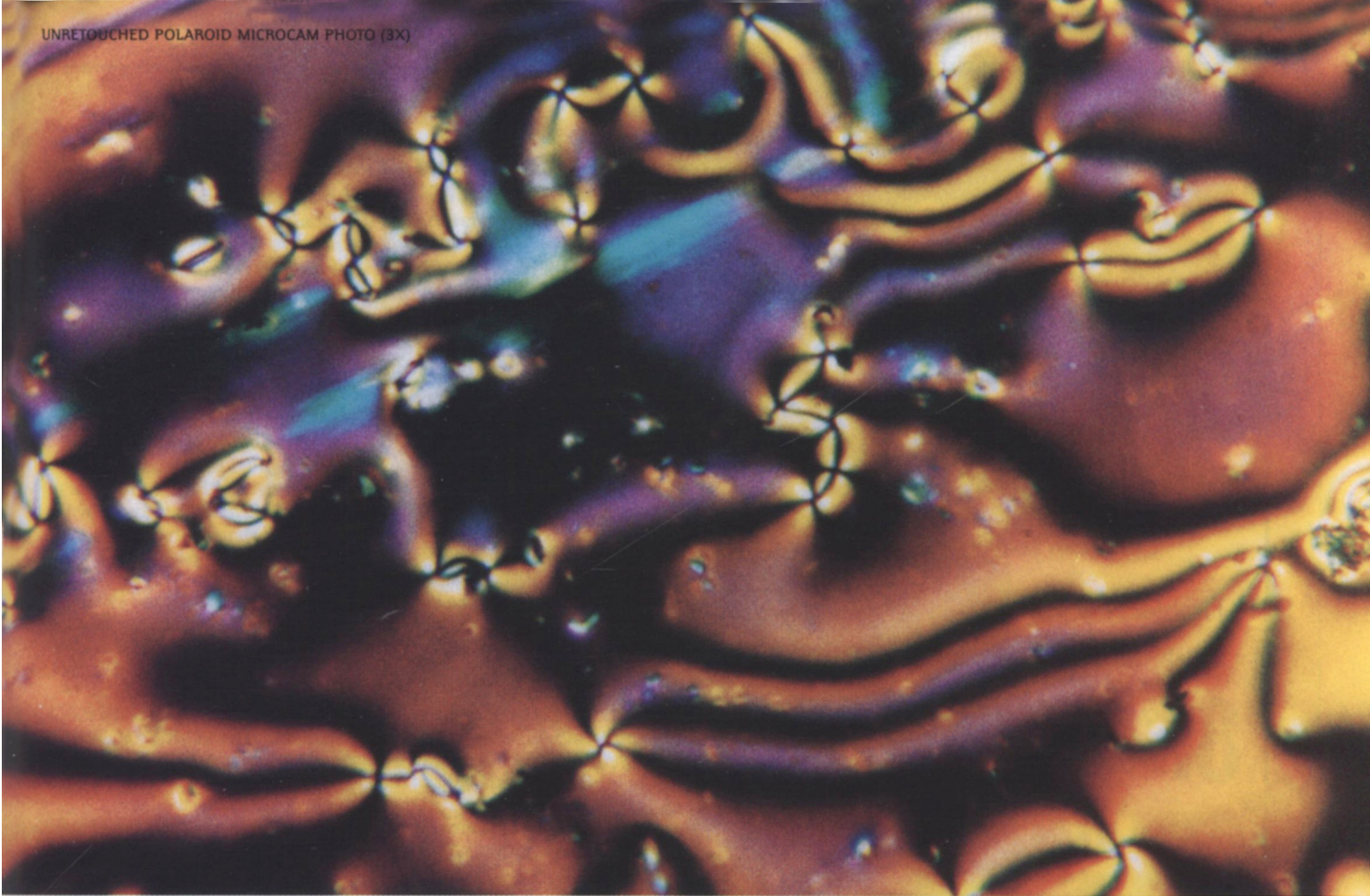
Materials Research Society of Japan (MRS-J)  
R-I. Yamamoto, University of Tokyo

Materials Research Society of Korea (MRS-Korea)  
J-T. Song, Hanyang University

Materials Research Society of Russia (MRS-Russia)  
I.V. Gorynin, Prometey Institute

Materials Research Society of Taiwan (MRS-T)  
L.J. Chen, National Tsing Hua University

Mexican Materials Research Society (Mexican-MRS)  
L.M. Gomez, Instituto de Fisica-Cuernavaca, UNAM



is

the Polaroid MicroCam the best way to get instant photographs OF YOUR SPECIMENS?

Why, the answer is as plain as the disclination points in your SMECTIC LIQUID CRYSTAL.



The Polaroid MicroCam is worth a very close look, indeed. The first thing you'll notice is its microscopic price.

At only \$795,

the MicroCam gives you instant, sharp, clear, hard copy outputs of your findings for a fraction of the cost of digital, 35mm and video solutions. Next, you'll discover how easy it is to use. The lightweight MicroCam fits right over the eyepiece or photo-tube of virtually any

light microscope. Filtration and exposure are automatic, and our single lens reflex feature means that you just view right through

the camera lens and push the button. Out comes a beautiful instant picture of your specimen. No pulling, peeling, or timing. That's it.

You can even use the MicroCam with our Polaroid PhotoPad Scanner as an affordable digital solution. Of course, the Polaroid MicroCam is backed by our 60-day money back guarantee so your purchase is always risk free. To order a MicroCam, to see the quality of images it captures, or for more information, call 800-662-8337 ext. 231.



You know, it's so inexpensive, you may even have enough money left over to buy new lab coats for all. **Polaroid**