

MRS

BULLETIN

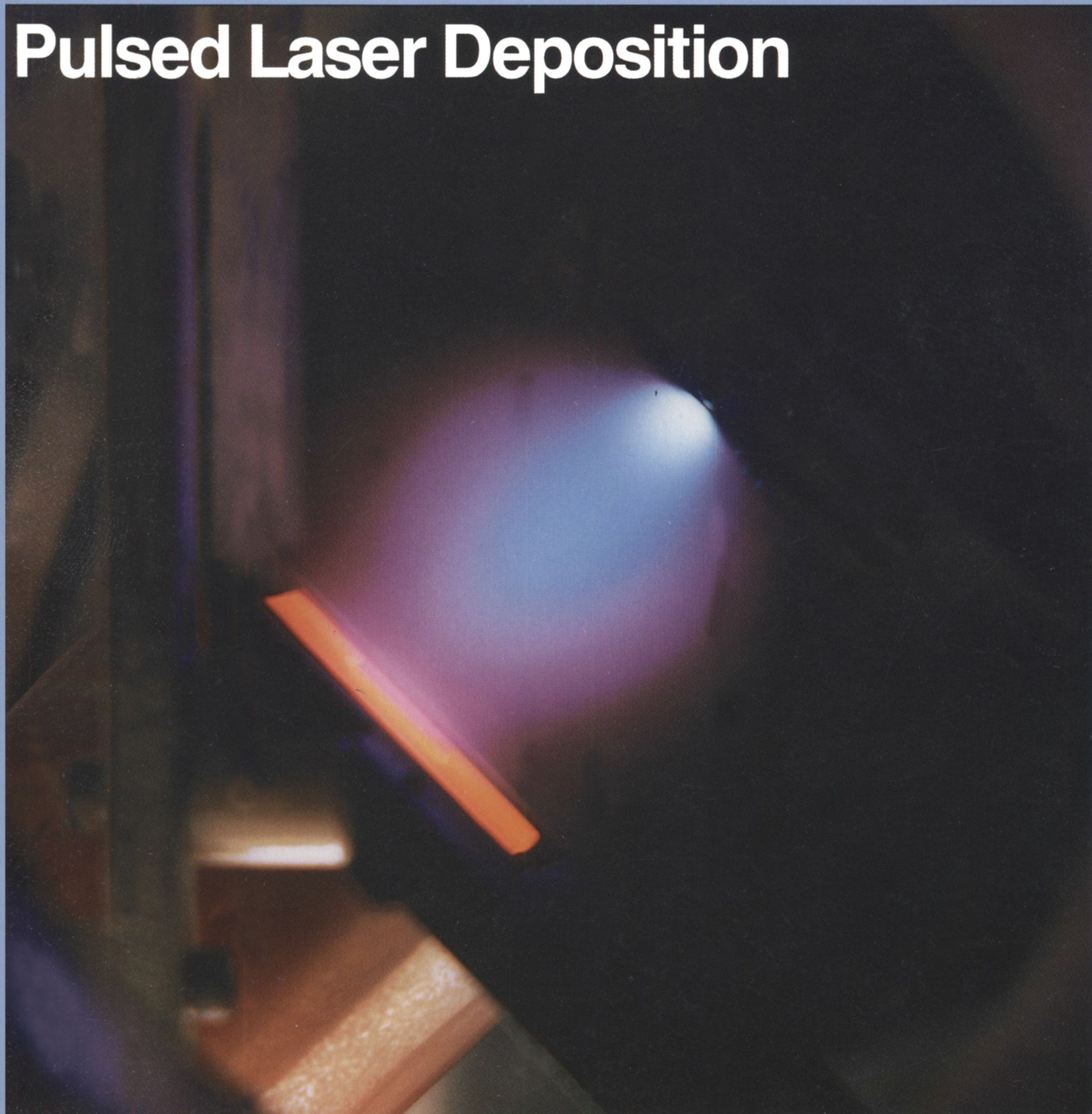
February 1992, Volume XVII, No. 2

Serving the International
Materials Research Community

A Publication of the Materials Research Society



Pulsed Laser Deposition



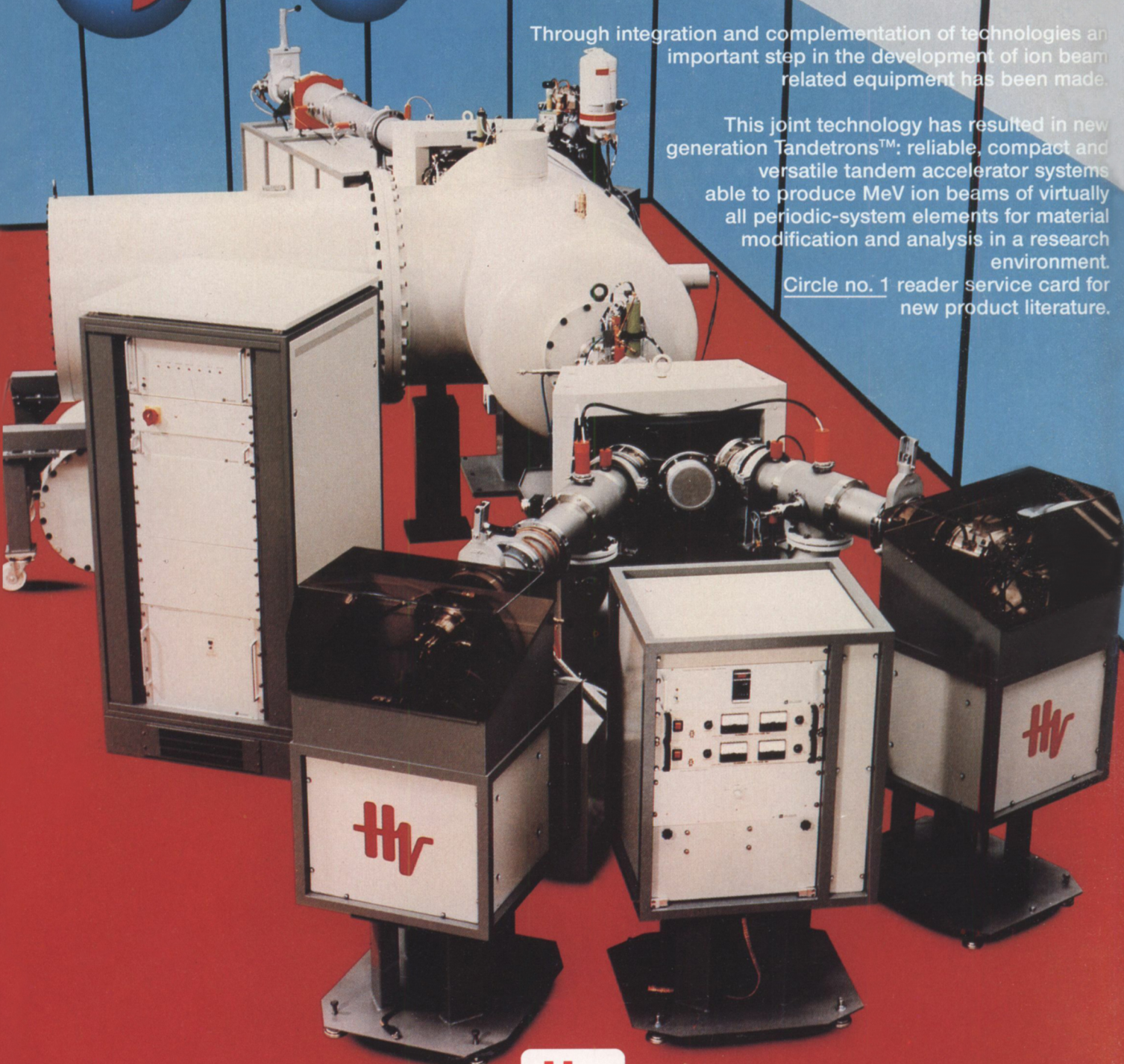
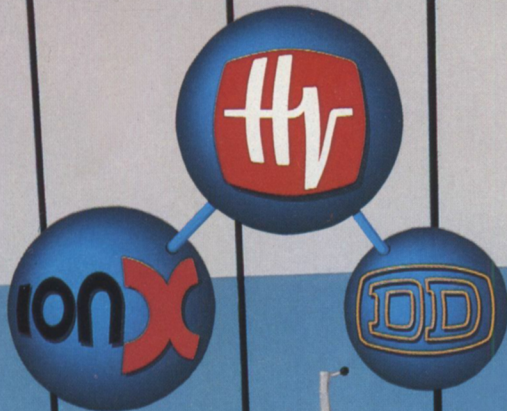
SUPERIOR PRODUCTS THROUGH JOINT TECHNOLOGY

When High Voltage Engineering acquired General Ionex a "cluster" in ion beam technology was born.

Through integration and complementation of technologies an important step in the development of ion beam related equipment has been made.

This joint technology has resulted in new generation Tandetrans™: reliable, compact and versatile tandem accelerator systems able to produce MeV ion beams of virtually all periodic-system elements for material modification and analysis in a research environment.

Circle no. 1 reader service card for new product literature.



**DIVISIONS
GENERAL IONEX
DOWLISH DEVELOPMENTS**



**More
Energy for Research**

HIGH VOLTAGE ENGINEERING EUROPA B.V.

P.O. Box 99, 3800 AB Amersfoort, The Netherlands, Phone: (+31) 33 - 619741. Fax: (+31) 33 - 615291. Telex: 79100 HIVEC NL

For Japan: MARUBUN CORPORATION, 6-1 Nishinomiya 1-chome, Ohta-machi, Chuo-ku, Tokyo, 103 Japan, Phone 03-3639-9861, Fax 03-3661-7473

For USA and Canada: HVEC, The Schrafft Center, Suite 602, 529 Main Street, Boston, MA 02129, Phone: (617) 241 5000, Fax: (617) 241 5005

A Publication of the Materials Research Society

Volume XVII, Number 2 ISSN: 0883-7694 CODEN: MRSBEA

PULSED LASER DEPOSITION

- 26 Pulsed Laser Deposition**
G.K. Hubler, Guest Editor
- 30 Pulsed Laser Deposition History and Laser-Target Interactions**
J. Cheung and J. Horwitz
- 37 Pulsed Laser Deposition of High T_c Superconducting Thin Films for Electronic Device Applications**
D.B. Chrisey and A. Inam
- 44 Novel Materials Applications of Pulsed Laser Deposition**
C.M. Cotell and K.S. Grabowski
- 54 Pulsed Laser Deposition: Future Directions**
T. Venkatesan, X.D. Wu, R. Muenchausen, and A. Pique

SPECIAL FEATURE

- 22 The Future of the Materials Initiative, National Laboratories, and Technology Policy**
An Interview with D. Allan Bromley

INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES

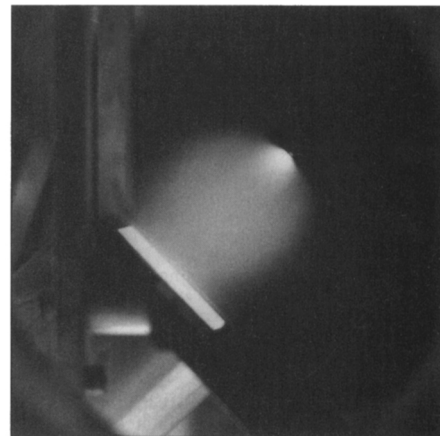
- 59 1991 MRS-Korea Conference and Aeronautics-Space Materials Exhibition Held in Seoul**
- 59 E-MRS Holds Summer School on Laser Ablation of Electronic Materials**

MRS NEWS

- 64 Materials Pursuit Gathers Steam at the 1991 MRS Fall Meeting**

DEPARTMENTS

- 4 Material Matters**
- 10 Research/Researchers**
- 16 Letters to the Editor**
- 18 Resources**
- 20 From Washington**
- 60 Upcoming Conferences**
- 75 Historical Note**
- 76 Book Reviews**
- 76 Advertisers in This Issue**
- 78 Classified**
- 80 Editor's Choice**



ON THE COVER: The pulsed laser deposition of a thin film of the high transition temperature superconductor $\text{YBa}_2\text{Cu}_3\text{O}_7$ is shown on the cover. A focused KrF excimer laser pulse impacts a sintered pellet of $\text{YBa}_2\text{Cu}_3\text{O}_7$ at a 45 deg angle. The laser-produced plume of ejected material flashes brightly in the visible due to interaction with the oxygen ambient. The distribution of ejected material in space is centered around the pellet's surface normal. To the left, and lying along the pellet's surface normal, is a MgO substrate, silver painted to a heater block whose temperature for deposition is $\sim 750^\circ\text{C}$. The stoichiometric plume of material deposits on the substrate. Once cooled, the film will demonstrate state-of-the-art superconducting transport properties. (Photograph taken by M.A. Savell.) For more on this topic, see "Pulsed Laser Deposition of High T_c Superconducting Thin Films for Electronic Device Applications" by D.B. Chrisey and A. Inam on p. 37.

About the Materials Research Society

The Materials Research Society (MRS), a nonprofit scientific association founded in 1973, promotes interdisciplinary goal-oriented basic research on materials of technological importance. Membership in the Society includes more than 10,000 scientists, engineers, and research managers from industrial, government, and university research laboratories in the United States and more than 40 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 50 topical symposia, and also sponsors numerous single-topic scientific meetings. The Society recognizes professional and technical excellence, conducts short courses, 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 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

Membership in MRS is \$70 annually for regular members, \$25 for students and retired members. Dues include an allocation of \$25 (\$15 for students and retirees) to a subscription to *MRS Bulletin*. Individual member subscriptions are for personal use only. Non-member subscription rates are \$95 for one calendar year (12 issues) within the U.S.A. and \$140 elsewhere. Single copies may be purchased for \$15 each. Send subscription orders to Subscription Department, Materials Research Society, 9800 McKnight Road, Pittsburgh, PA 15237.

MRS Bulletin is included in Current Contents/Physical, Chemical & Earth Sciences™ and Research Alert. 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.

MRS BULLETIN

Publisher
G. A. Oare

Technical Editor
E. L. Fleischer

Assistant Editor
F. M. Wieloch

Copy Editor
D. M. Varner

Art Director
C. Love

Design/Production
W. A. McCalip, J. Probert

Editorial Assistants
J. Dininny, M. M. Costello

Advertising and Circulation
M. E. Kaufold

Associate Editor—Europe
I. W. Boyd
University College London
Dept. of Electronic and
Electrical Engineering
Torrington Place
London WC1E 7JE
United Kingdom
71-387-7050 ext. 3956 or 7304

Editorial and Advertising Offices
9800 McKnight Road
Pittsburgh, PA 15237
Telephone (412)-367-3036
Fax (412) 367-4373

MRS Office of Public Affairs
2000 Florida Ave. NW, Third Floor
Washington, DC 20009
Telephone (202) 483-6771

Guest Editor
G. K. Hubler

Special Contributors
K. J. Anderson, C. D. Chaffee,
S. M. Prokes

CHAIRMAN—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
Taiwan, China

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

H-D. Li
Tsinghua University
Beijing, China

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

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

T. Sugano
University of Tokyo
Tokyo, Japan

D. L. Weaire
University of Dublin
Dublin, Ireland

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. Léon
Universidade de Santiago
Vigo, Spain

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

S. Namba
Osaka University
Osaka, Japan

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

J. Soares
Universidade de Lisboa
Lisboa, Portugal

K. C. Taylor
General Motors Research Laboratories
Warren, Michigan, USA

MRS BULLETIN PUBLICATIONS SUBCOMMITTEE

A. Barkatt
Catholic University of America
Washington, DC

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

M. R. Libera
Stevens Institute of Technology
Hoboken, New Jersey

G. J. McCarthy
North Dakota State University
Fargo, North Dakota

J. M. Phillips
AT&T Bell Laboratories
Murray Hill, New Jersey

S. M. Prokes
Naval Research Laboratory
Washington, DC

W. H. Sutton
United Technologies
Research Center
East Hartford, Connecticut

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

1992 MRS EXECUTIVE COMMITTEE

President
G. S. Cargill III
IBM T. J. Watson Research Center

First Vice President and President-Elect
S. T. Picraux
Sandia National Laboratories

Second Vice President
J. C. Bravman
Stanford University

Secretary
L. A. Boatner
Oak Ridge National Laboratory

Treasurer
C. B. Duke
Xerox Research Laboratories

Immediate Past President
J. B. Roberto
Oak Ridge National Laboratory

Executive Director
Materials Research Society
John B. Ballance

INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES

President
R. P. H. Chang
Northwestern University, USA
Tel. (708) 491-3598; Fax (708) 491-4181

Vice President
Paul Siffert
Centre de Recherches Nucléaires, France
Tel. (88) 28 65 43; Fax (88) 28 09 90

Secretary
Rodney C. Ewing
University of New Mexico, USA
Tel. (505) 277-4163; Fax (505) 277-0090

Treasurer
Shigeyuki Somiya
Nishi Tokyo University, Japan
Tel. (81) 3 417 2866; Fax (81) 3 415 6619

IUMRS ADHERING BODIES

Australian Materials Science Committee (AMSC)
J. S. Williams

Chinese Materials Research Society (C-MRS)
Hengde Li

European Materials Research Society (E-MRS)
B. Stritzker

Materials Research Society (MRS)
G. S. Cargill III

Materials Research Society of India (MRS-I)
C. N. R. Rao

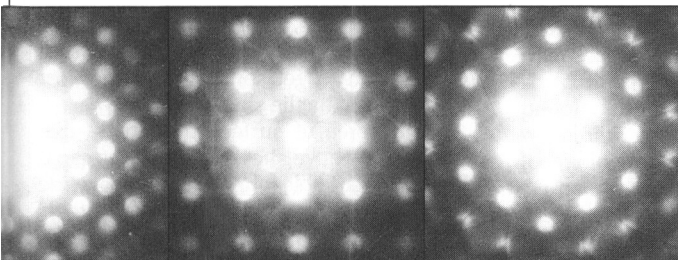
Materials Research Society of Japan (MRS-J)
Masaki Hasegawa

Materials Research Society of Korea (MRS-Korea)
Min Che Chon

Materials Research Society of Taiwan (MRS-T)
Li-chung Lee

Mexican Materials Research Society (Mexican MRS)
M. J. Yacaman

THE BEST WAY TO GET AN ANGLE ON CRYSTALS.



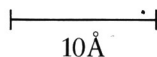
High resolution, electron microdiffraction analysis may require several tilt angles.

If you need to determine elemental composition and molecular or atomic structure of crystals in minerals, metals, ceramics or polymers, our JEM-2010 is the best high resolution, analytical microscope for the job.

The JEM-2010 is a 200 kV TEM with superior optics and high probe current. It is optimized for analytical performance

not only in the analytical configuration, but also in the ultra-high resolution configuration as well.

With the EDS accessory, elemental analyses may be performed using probes as small as 10Å.

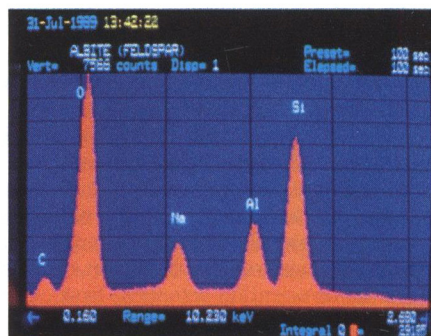


Equipped with EDS, the JEM-2010 is capable of high sensitivity elemental analyses using probes as small as 10Å in diameter.

With its analytical pole piece, it offers 2.3Å resolution over 30° of tilt and an x-ray collection angle of 0.13 steradians. That is the best combination of analytical features of any instrument in the 200 kV class.

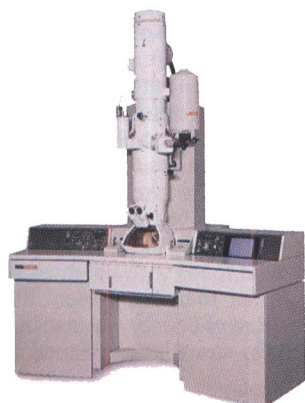
But the JEM-2010 is more than an analytical microscope.

Equipped with the interchangeable, high resolution pole piece, the JEM-2010 is also an ultra-high resolution microscope with 1.9Å resolution over 10° of tilt and an x-ray collection angle of 0.07 steradians.



High sensitivity elemental analysis is possible with the addition of an EDS system.

For purposes of analyzing obliquely oriented crystalline material in metal, mineral, ceramic or polymer matrices, the JEM-2010 offers 2.3Å resolution with a tilt angle of ± 30 degrees.



JEM-2010 Transmission Electron Microscope



Circle No. 4 on Reader Service Card.

Let us tell you more. Call (508) 535-5900. Or write JEOL USA, Inc., 11 Dearborn Road, Peabody, MA 01960.