

MRS

BULLETIN

Serving the International
Materials Research Community

September 1991, Volume XVI, No. 9

A Publication of the Materials Research Society



Biomedical Materials



L.V '80
For
Peggy

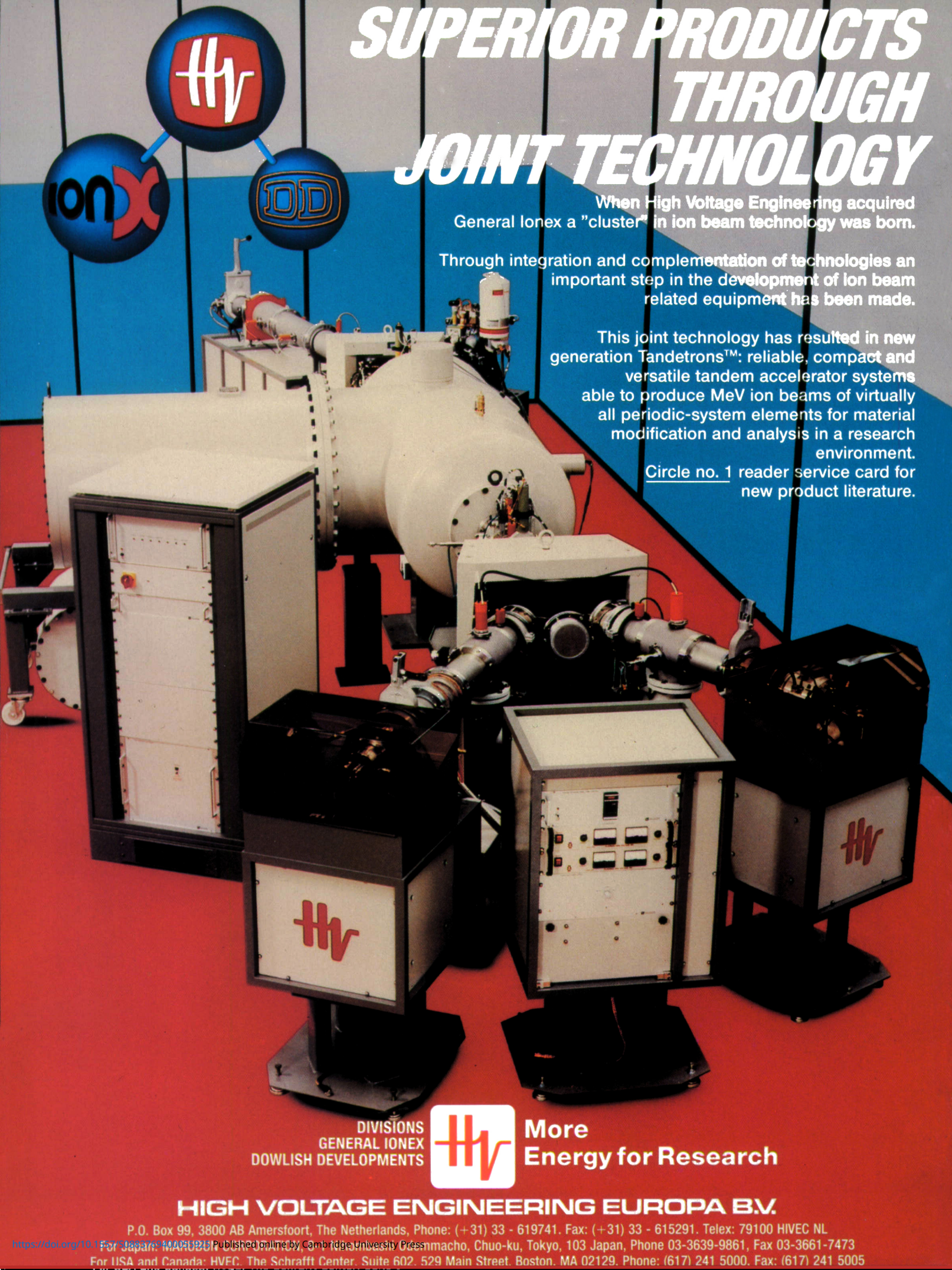
SUPERIOR PRODUCTS THROUGH JOINT TECHNOLOGY

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: MAIUBB, Published online by Cambridge University Press, Macho, 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 XVI, Number 9 ISSN: 0883-7694 CODEN: MRSBEA

BIOMEDICAL MATERIALS

- 22 Biomedical Materials**
S.A. Barenberg and E.P. Mueller,
Guest Editors
- 26 Report of the Committee
to Survey Needs and
Opportunities for the
Biomaterials Industry**
S.A. Barenberg
- 33 Overview of Biomedical
Materials**
M.N. Helmus
- 39 Regulation of
"Biomaterials" and
Medical Devices**
E.P. Mueller, R.G. Kammula,
and D.E. Marlowe
- 42 Environmentally Sensitive
Polymers and Hydrogels**
A.S. Hoffman
- 47 Drug Delivery Systems**
R.S. Langer
- 50 Cardiovascular Materials**
R.C. Eberhart, H-H. Huo,
and K.D. Nelson
- 55 The Bone-Biomaterial
Interface for Load-Bearing
Implants**
R.M. Pilliar, J.E. Davis,
and D.C. Smith
- 62 Bioceramics**
L.L. Hench and J.H. Wilson
- 75 Biostability of Biomedical
Polymers**
J.M. Anderson and Q. Zhao
- 78 Materials, Biotechnology,
and Blood Substitutes**
N. Kossovsky and D. Millett

**82 Effective Technology
Transfer Through Active
Licensing**

N.L. Levy and E. Coles

**86 Biomaterials in an
Emerging National
Materials Science Agenda**

S.A. Barenberg and E.P. Mueller

INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES

**88 MRS-I is Joint Sponsor of
New Materials Seminar**

88 C-MRS is Official

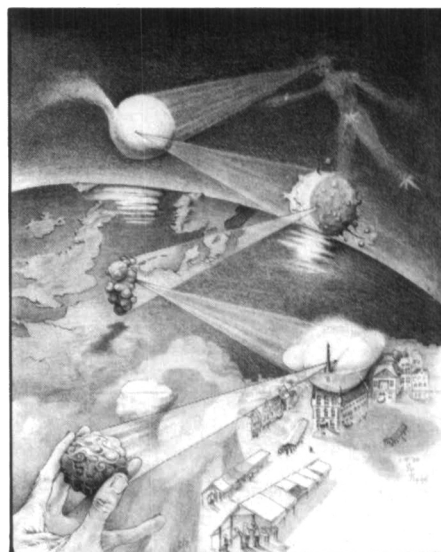
MRS NEWS

5 MRS Treasurer's Report

DEPARTMENTS

- 4 Letter from the President**
- 7 Material Matters**
- 8 Research/Researchers**
- 16 From Washington**
- 18 Resources**
- 89 Journal of Materials
Research**
- 90 Historical Note**
- 92 Calendar**
- 94 Advertisers in This Issue**
- 95 Classified**

ON THE COVER: Artist Leo Vroman describes his work as follows: "I imagined a simple atomic nucleus large enough to hold in my hand so that I could see the subnuclear particles. Then, the entire atom would be at least as large as the town hall of Gouda (the Netherlands, where I was born). A relatively small organic molecule such as cyclic AMP would then be almost as large as Holland. Placing that molecule in one cell of the pituitary gland, I would have to draw that cell as large as—and for convenience viewed as far away as—the moon. To place that cell inside the entire pituitary, that gland would have to be as large and as far away as the sun; and to contain such a gland, the human's dimensions must reach beyond the solar system." Leo Vroman is a senior engineer scientist in the Department of Chemical Engineering at Columbia University.



MRS BULLETIN

Materials Research Society • 9800 McKnight Road • Pittsburgh, PA 15237

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 is pending 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 \$65 annually for regular members, \$20 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 \$88 for one calendar year (12 issues) within the U.S.A. and \$128 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. Appman, 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 WC1 E7 JE
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 Editors
S.A. Barenberg, E.P. Mueller

Special Contributors
K. J. Anderson, Paul K. Bryant

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. R. Rao
Defence Metallurgical Research
Laboratory
Hyderabad, India

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

T. Sugano
University of Tokyo
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

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

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

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

1991 MRS EXECUTIVE COMMITTEE

President
J. B. Roberto
Oak Ridge National Laboratory

**First Vice President
and President-Elect**
G. S. Cargill III
IBM T. J. Watson Research Center

Second Vice President
S. T. Picraux
Sandia National Laboratories

Secretary
C. M. Jantzen
Westinghouse Savannah River Co.

Treasurer
C. B. Duke
Xerox Research Laboratories

Immediate Past President
R. R. Chianelli
Exxon Research and Engineering

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

INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES

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

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

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

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

IUMRS ADHERING BODIES

Australian Materials Research Committee (AMRC)
Prof. J. S. Williams

Chinese Materials Research Society (C-MRS)
Prof. Heng-De Li

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

Materials Research Society (MRS)
Dr. James B. Roberto

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

Materials Research Society of Japan (MRS-J)
Prof. Shigeyuki Sömiya

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

Materials Research Society of Taiwan (MRS-T)
Dr. Ping-Tien Wu

Mexican Materials Research Society (Mexican MRS)
Dr. M. J. Yacamán

How Does Your Column Stack Up?

Compare your present SEM to the ElectroScan ESEM™



	ESEM	SEM
5nm Spatial Resolution	✓	✓
Secondary/Backscatter/EDX	✓	✓
High Vacuum Secondary Imaging	✓	✓
High Pressure (20 Torr) Environment	✓	✗
High Pressure Secondary Imaging	✓	✗
Handles Any Type of Sample	✓	✗
Drying Never Required	✓	✗
Coating Never Required	✓	✗
Charging Never a Problem	✓	✗
Beam Voltage Never Restricted	✓	✗
Insensitive to Light	✓	✗
Insensitive to Contamination	✓	✗
Images Liquid Specimens	✓	✗
Images Red-hot Surfaces	✓	✗
Images Dynamic Reactions	✓	✗
VCR Output Standard	✓	?
Digital/Color Imaging Standard	✓	?
Mouse/Touchscreen Operation	✓	?
External Gun/Anode Adjustment	✓	?
VME Bus Architecture	✓	?
Maximizes Lab Throughput	✓	?
Reveals New Information	✓	?
State-of-the-Art Instrument	✓	?

The answer is obvious.



SEEING THINGS YOU'VE NEVER SEEN BEFORE

ElectroScan Corporation 66 Concord Street, Wilmington, MA 01887 (508) 988-0055

Circle No. 4 on Reader Service Card.