Volume 21, Number 3

June 2015

# Microscopy and Microanalysis



CAMBRIDGE UNIVERSITY PRESS ISSN 1431-9276

μm

0

### **DIATOME** DIAMOND KNIVES

### 40 YEARS of development, manufacturing, and customer service

What have we achieved in this period?

**ultra 45**° the first diamond knife with an absolutely score-free, hydrophilic cutting edge.

**Semi** the first diamond knife for alternating sectioning ultrathin/semithin.

**Cryo** the diamond knife for sectioning at low temperature.

**histo** the first diamond knife for semithin sections for light microscopy.

**ultra 35**° the diamond knife for optimized sectioning results in almost all applications.

**STATIC LINE II** the ionizer for eliminating electrostatic charging in ultramicrotomy.

 $\ensuremath{\text{cryo-P}}$  a cryo knife with a patented platform for section pick up.

**Cryo immuno** the optimized cryo diamond knife for the Tokuyasu technique.

**ultra Sonic** the oscillating diamond knife for room temperature sectioning.

**Cryotrim** 45 and 25 optimizing trimming with diamond blades.

ultra AFM & cryo AFM the first diamond knives for AFM at room and low temperatures.

**Cryo 25°** for sectioning frozen hydrated specimens.

### What services can we offer you?

- Technical assistance in all fields of ultramicrotomy.
- Free sectioning tests for all types of samples.
- Make use of our many years of experience in perfecting our knives.
- Custom knives, tools, and boats.
- Special purchase programs.
- Workshops and training.



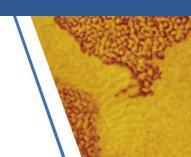
P.O. Box 550 1560 Industry Rd. Hatfield, Pa 19440 Tel: (215) 412-8390 Fax: (215) 412-8450 email: sgkcck@aol.com www.emsdiasum.com





For more information, please call or write us today, or visit us online at: www.emsdiasum.com

16



## Microscopy and Microanalysis

### An International Journal for the Biological and Physical Sciences

THE OFFICIAL JOURNAL OF	MICROSCOPY SOCIETY OF AME	RICA		
	MICROANALYSIS SOCIETY			
	MICROSCOPICAL SOCIETY OF CANADA /			
	SOCIÉTÉ DE MICROSCOPIE DU	J CANADA		
	MEXICAN MICROSCOPY SOCIET			
	BRAZILIAN SOCIETY FOR MICROSCOPY AND MICROANALYSIS			
	VENEZUELAN SOCIETY OF ELECTRON MICROSCOPY			
	EUROPEAN MICROBEAM ANALY	SIS SOCIETY		
	AUSTRALIAN MICROSCOPY AN	D MICROANALYSIS SOCIETY		
	PORTUGUESE SOCIETY FOR MIC	CROSCOPY		
	ROYAL MICROSCOPICAL SOCIE	TY		
PUBLISHED IN AFFILIATION WITH				
	GERMAN SOCIETY FOR ELECTRO			
	BELGIAN SOCIETY FOR MICROS			
	MICROSCOPY SOCIETY OF SOU	MICROSCOPY SOCIETY OF SOUTHERN AFRICA		
Editor in Chief	Editor, Biological Applications	Special Issues and Reviews Editor		
Editor, Biological Applications	William A. Russin	Jay Jerome		
Robert L. Price	Biological Imaging Facility	Vanderbilt University Medical Center		
Cell and Developmental Biology and	Department of Neurobiology	Nashville, TN 37232		
Anatomy	Northwestern University	e-mail: jay.jerome@vanderbilt.edu		
University of South Carolina	Evanston, IL 60208			
Columbia, SC 29209	e-mail: w-russin@northwestern.edu	Deals Destaux Editors		
e-mail: Bob.Price@uscmed.sc.edu		Book Review Editor		
e mail: Dobli neeg asemealseleda	Editor Dialogical Applications	Cynthia S. Goldsmith		
	Editor, Biological Applications	Centers for Disease Control		
Editor, Materials Applications	Heide Schatten	Atlanta, GA 30333		
David Bell	Veterinary Pathobiology	e-mail: csg1@cdc.gov		
School of Engineering & Applied Sciences	University of Missouri-Columbia			
Center for Nanoscale Systems	Columbia, Missouri 65211-5030 e-mail: schattenh@missouri.edu	M&M Program Guide Editor		
Harvard University	e-mail: schattenn@missouri.edu	Richard E. Edelmann		
Cambridge, MA 02138		Miami University		
e-mail: dcb@seas.harvard.edu	Editor, Microanalysis	Oxford, OH 45056		
	John Mansfield	e-mail: edelmare@muohio.edu		
Editor, Scanning Probe	Electron Microbeam Analysis Lab			
Microscopies	North Campus, 417 SRB	<b>Proceedings</b> Editor		
Andrew Magyar	University of Michigan	Gail Celio		
Center for Nanoscale Systems	Ann Arbor, MI 48109-2143	University of Minnesota		
Harvard University	e-mail: jfmjfm@umich.edu	St. Paul, MN 55108		
Cambridge, MA 02138		e-mail: celio001@umn.edu		
e-mail: amagyar@cns.fas.harvard.edu	Editor, Correlative and Emerging			
	Microscopy Applications	A destinistanting T ditag		
Editor, Atom Probe	Vinayak P. Dravid	Administrative Editor		
Thomas Kelly	Materials Science and Engineering	John Shields		
Cameca Instruments, Inc.	Northwestern University	University of Georgia		
A Business Unit of AMETEK, Inc.	Evanston, Illinois 60208-3105	Athens, GA 30602		
Madison, WI 53711-4951	e-mail: v-dravid@northwestern.edu	e-mail: jpshield@uga.edu		
e-mail: Thomas.Kelly@ametek.com				
e man. momas.iveny@ametex.com	Editor Diont Diology Applications			
	Editor, Plant Biology Applications			
	Rosemary White			
	CSIRO Plant Industry			
	Canberra, ACT 2601, Australia			

e-mail: rosemary.white@csiro.au



© MICROSCOPY SOCIETY OF AMERICA 2015

### **Editorial Board**

Ralph Albrecht Ilke Arslan Grace Burke Barry Carter Wah Chiu Niels de Jonge Alberto Diaspro Elizabeth Dickey Mark Ellisman Pratibha Gai Marija Gajdardziska-Josifovska Dale Johnson Paul Kotula William Landis Eric Lifshin Charles Lyman Dale Newbury Iean-Paul Revel David Smith Nan Yao Nestor Zaluzec

University of Wisconsin, Madison, Wisconsin Pacific Northwest Laboratory, Richland, Washington University of Manchester, Manchester, England University of Connecticut, Storrs, Connecticut Baylor College of Medicine, Houston, Texas INM Institute for New Materials, Saarbrücken, Germany University of Genoa, Italy North Carolina State University, Raleigh University of California at San Diego, San Diego, California University of York, United Kingdom University of Wisconsin-Milwaukee, Milwaukee, Wisconsin University of South Florida, Tampa, Florida Sandia National Labs, Albuquerque, New Mexico University of Akron, Akron, Ohio SUNY at Albany, Albany, New York Lehigh University, Bethlehem, Pennsylvania National Institute of Standards and Technology, Gaithersburg, Maryland California Institute of Technology, Pasadena, California Arizona State University, Tempe, Arizona Princeton University, Princeton, New Jersey Argonne National Laboratory, Argonne, Illinois

### **Editorial Board Representatives from Affiliated Societies**

Masashi Watanabe	Lehigh University (MAS)
Gautam Kumar Dey	Bhabha Atomic Research Centre (EMSI)
Gema Gonzalez	Venezuelan Institute for Scientific Investigation (Venezuela)
Michael Robertson	Acadia University, Wolfville, Nova Scotia (Canada)
Brendan Griffin	University of Western Australia (AMMS)
Guillermo Solorzano	Pontificia Universidade Catolica, Rio de Janeiro (Brazil)
Mike Matthews	Atomic Weapons Establishment, Reading, Great Britain (EMAS)
Miguel Yacaman	Mexico Institute for Nuclear Research (Mexico)
Henrique Almeida	Universidade do Porto (Portugal)

### **Founding Editor**

Jean-Paul Revel California Institute of Technology, Pasadena, California

### **Previous Editors-in-Chief**

Dale Johnson	University of South Florida, Tampa, Florida
Charles Lyman	Lehigh University, Bethlehem, Pennsylvania

This journal is part of the **Cambridge Journals Online** service. Access to online tables of contents and article abstracts is available to all researchers at no cost. Access to full-text articles online is provided to those with online subscription. Online subscriptions must be activated. Once your subscription is activated, free access to past, present, and forthcoming articles is available at:

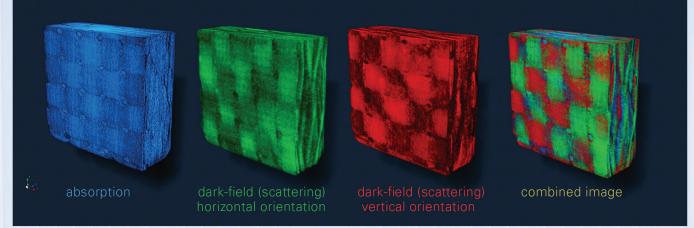
### Microscopy and Microanalysis website: journals.cambridge.org/MAM.

Instructions for authors submitting manuscripts may be found at journals.cambridge.org/MAM. Select "Further Information" then select "Instructions for Contributors." An abbreviated version of these instructions will be published in the first issue (February) of each volume.



### **Bruker microCT**

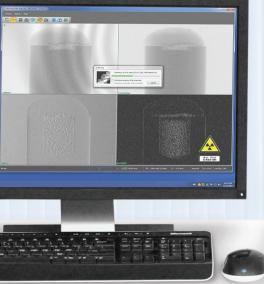
### LABORATORY PHASE CONTRAST X-RAY MICROTOMOGRAPHY



volume rendering from the scanning results of a carbon-fiber composite material

### SkyScan1294: World's First Commercially Available Phase-Contrast Micro-CT





- simultaneous retrieval of absorption, differential phase and dark-field (scattering) X-ray images,
- three-grating X-ray interferometer with 30keV design energy,
- world's fastest hierarchical InstaRecon® 3D reconstruction
- microfocus 100W X-ray source, 20-60keV peak energy,
- five position filter changer for energy window selection,
- 11 megapixel cooled CCD X-ray detector,
- surface and volume rendering, export results to phones and tablets,
- compact, fully shielded desk-top instrument.



### bruker-microct.com

microtomography

### Innovation with Integrity

#### Microscopy AND Microanalysis

*Microscopy and Microanalysis* publishes original research papers dealing with a broad range of topics in microscopy and microanalysis. These include articles describing new techniques or instrumentation and their applications, as well as papers in which established methods of microscopy or microanalysis are applied to important problems in the fields of biology or materials science. Microscopy and microanalysis are defined here in a broad sense, and include all current and developing approaches to the imaging and analysis of microstructure. The criteria for acceptance of manuscripts are the originality and significance of the research, the quality of the microscopy or microanalysis involved, and the interest for our readership.

Four types of communications are published in the Journal. **Regular Articles** are of substantial length and describe the findings of an original research project that satisfies the aims and scope of the Journal, described above. **Review Articles** summarize the current status of an important area within the aims and scope of the Journal. **Letters to the Editor** usually contain comments on recent articles that have appeared in the Journal. **Book Reviews** are also published, but these are solicited only through the Book Review Editor.

#### Instructions for Contributors

Instructions for authors contributing manuscripts may be found at http://mc.manuscriptcentral.com/mam under "Resources: Instructions and Forms." Authors may also visit http://www.journals.cambridge.org/jid\_MAM, select "Further Information," and then select "Instructions for Contributors." An abbreviated version of these instructions will be published in the first issue (February) of each volume.

#### **Copyright Information**

Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, review, or thesis); that it is not under consideration for publication elsewhere; that its publication has been approved by all coauthors, if any, as well as by the responsible authorities at the institute where the work has been carried out; that, if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the Microscopy Society of America; that the manuscript will not be published elsewhere in any language without the consent of the copyright holders; and that written permission of the copyright double is obtained by the authors for material used from other copyrighted sources.

All articles published in this journal are protected by copyright, which covers the exclusive rights to reproduce and distribute the article (e.g., as offprints), as well as all translation rights. No material published in this journal may be reproduced photographically or stored on microfilm, in electronic data bases, video disks, etc., without first obtaining written permission from the publisher.

The use of general descriptive names, trade names, trademarks, etc., in this publication, even if not specifically identified, does not imply that these names lack protection by the relevant laws and regulation.

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by Cambridge University Press, provided that the appropriate fee is paid directly to Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, USA (Tel: (508) 750-8400), stating the ISSN (1431-9276), the volume, and the first and last page numbers of each article copied. The copyright owner's consent does not include copying for general distribution, promotion, new works, or resale. In these cases, specific written permission must first be obtained from the publisher.

#### Disclaimer

The Microscopy Society of America, the other societies stated, and Cambridge University Press cannot be held responsible for errors or for any consequences arising from the use of the information contained in this journal. The appearance of scientific reports and/or workshops, or any other material in *Microscopy and Microanalysis* does not constitute an endorsement or approval by The Microscopy Society of America of the findings, data, conclusions, recommendations, procedures, results, or any other aspect of the content of such articles. The appearance of advertising in *Microscopy and Microanalysis* does not constitute an endorsement or approval by The Microscopy Society of America of the quality or value of the products advertised or any of the claims, data, conclusions, recommendations, procedures, results, or any other information included in the advertisements.

While the advice and information in this journal is believed to be true and accurate at the date of its going to press, neither the authors, the editors, nor the publisher can accept any legal responsibility for any errors or omissions that may be made.

#### Subscription Information

*Microscopy and Microanalysis* is published bimonthly in February, April, June, August, October, and December by Cambridge University Press. Three supplements (*Meeting Guide*, *Program Guide*, and *Proceedings*) are published in June and August.

**Society Rates:** Members of the Microscopy Society of America should contact the MSA Business Office for all subscription inquiries: Microscopy Society of America, Hachero Hill, Inc., 11260 Roger Bacon Drive, Suite 402, Reston, VA 20190, Tel.: (703) 964-1240, Ext. 14, E-mail: nicoleguy@mindspring.com, URL: www.msa.microscopy.org. Members of other affiliated societies should contact their respective society business offices for all subscription inquiries.

**Subscription Rates:** Institutions print and electronic: US \$1705.00 in the USA, Canada, and Mexico; UK  $\pounds$ 1025.00 + VAT elsewhere. Institutions online only: US \$1264.00 in the USA, Canada, and Mexico; UK  $\pounds$ 765.00 + VAT elsewhere. Individuals print plus online: US \$522.00 in the USA, Canada, and Mexico; UK  $\pounds$ 317.00 + VAT elsewhere. Prices include postage and insurance.

**USA, Canada, and Mexico:** Subscribers in the USA, Canada, and Mexico should send their orders, with payment in US dollars or the equivalent value in Canadian dollars, to: Cambridge University Press, Customer Services Department (Journals), 100 Brook Hill Drive, West Nyack, NY 10994-2133, USA. Tel: (845) 353-7500. Fax: (845) 353-4141. Orders may be phoned direct (toll free): (800) 872-7423. E-mail: journals\_subscriptions@cup.org.

**Outside North America:** Subscribers elsewhere should send their orders, with payment in sterling, to: Customer Services Department (Journals), Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge, CB2 8RU, UK. Tel: +44 (0)1223 326070. Fax: +44 (0)1223 325150. E-mail: journals@cambridge.org

**Change of address:** Allow six weeks for all changes to become effective. All communications should include both old and new addresses (with postal codes) and should be accompanied by a mailing label from a recent issue. Society members should contact their respective society business offices to inform them of address changes.

#### **Editorial Office**

Robert L. Price, Editor in Chief, Department of Cell and Developmental Biology and Anatomy, School of Medicine, University of South Carolina, 6439 Garner's Ferry Road, Bldg. 1 B-60, Columbia, SC 29209, USA; Tel: (803) 216-3824; Fax: (803) 733-3212; E-mail: Bob.Price@uscmed.sc.edu.

#### Office of Publication

Cambridge University Press, 32 Avenue of the Americas, New York, NY 10013-2473, USA; Tel: (212) 337-5000; Fax: (212) 337-5959.

#### **Advertising Sales & Production**

Kelly Miller, M.J. Mrvica Associates, Inc., 2 West Taunton Avenue, Berlin, NJ 08009, USA; Tel: (856) 768-9360; Fax: (856) 753-0064.

© 2015 by Microscopy Society of America. Printed in the United States on acid-free paper. Periodicals postage paid at New York, NY, and additional mailing offices. Return postage guaranteed. Postmaster: Send address changes in the U.S.A. and Canada to *Microscopy and Microanalysis*, Subscription Department, Cambridge University Press, 100 Brook Hill Drive, West Nyack, NY 10994-2133.



Be confident you can perform electron backscatter diffraction analysis in high resolution. Introducing the PECS<sup>™</sup> II instrument to automate preparation of damage free surfaces, cross sections and deposit coatings to enhance your understanding of grain size, texture and orientation.



Nanostructures Lecture	

### You've come a long way.

### But is your current instrument holding you back?

The success of your university is limited by the funding of your TEM lab. With instruments from FEI, you could publish more papers, gain more prestige for your university, and secure more funding for your TEM lab.



### Learn more at FEI.com/DiscoverMore

### Microscopy and Microanalysis

### An International Journal for the Biological and Physical Sciences

Volume 21, Number 3		
June 2015	Atom-Probe Tomographic Analyses of Hydrogen Interstitial Atoms in Ultrahigh Purity Niobium Yoon-Jun Kim and David N. Seidman	535
	Practical Issues for Atom Probe Tomography Analysis of III-Nitride Semiconductor Materials Fengzai Tang, Michael P. Moody, Tomas L. Martin, Paul A.J. Bagot, Menno J. Kappers, and Rachel A. Oliver	544
	Characterization of Nanoporous Materials with Atom Probe Tomography Björn Pfeiffer, Torben Erichsen, Eike Epler, Cynthia A. Volkert, Piet Trompenaars, and Carsten Nowak	557
	Low-Temperature Cathodoluminescence Investigations of High-Quality Zinc Oxide Nanorods Bartlomiej S. Witkowski, Lukasz Wachnicki, Sylwia Gieraltowska, Anna Reszka, Bogdan J. Kowalski, and Marek Godlewski	564
	Microstructure and Mechanical Properties of Ti Cold-Spray Splats Determined by Electron Channeling Contrast Imaging and Nanoindentation Mapping Dina Goldbaum, Richard R. Chromik, Nicolas Brodusch, and Raynald Gauvin	570
	A Shear Strain Route Dependency of Martensite Formation in 316L Stainless Steel Suk Hoon Kang, Tae Kyu Kim, Jinsung Jang, and Kyu Hwan Oh	582
	Growth Directions of Precipitates in the Al-Si-Mg-Hf Alloy Using Combined EBSD and FIB 3D-Reconstruction Techniques Xueli Wang, Yuan Xing, Huilan Huang, Yanjun Li, Zhihong Jia, and Qing Liu	588
	Importance of Carbon Contamination in High-Resolution (FEG) EPMA of Silicate Minerals Ben Buse and Stuart Kearns	594
	Den buse and Stuart Kearns Microscopy and Microanalysis of an Extreme Case of Salt and Biodegradation in 17th Century Wall Paintings Milene Gil, Maria Rosário Martins, Maria Luisa Carvalho, Cátia Souto, Stephane Longelin, Ana Cardoso, José Mirão, and António Estevão Candeias	606
	Statistical Study of Beam-Induced Motion of Gold Adatoms by a Scanning TEM <i>Wei Zhou, Xin Li, and Guo-Zhen Zhu</i>	617
	The Advantages of an Attenuated Total Internal Reflection Infrared Microspectro- scopic Imaging Technique for the Analysis of Polymer Laminates <i>Chen Ling and Andre J. Sommer</i>	626
	Burgers Vector Analysis of Vertical Dislocations in Ge Crystals by Large-Angle Convergent Beam Electron Diffraction Heiko Groiss, Martin Glaser, Anna Marzegalli, Fabio Isa, Giovanni Isella, Leo Miglio, and Friedrich Schäffler	637

**On the Cover:** Multi-photon microscope image showing BON cells (green) in liver microvasculature (red). For further information please see Goswamee et al., pp. 655–665.

*Microscopy and Microanalysis* website: http://www.journals.cambridge.org/MAM Indexed in Chemical Abstracts, Current Contents, BIOSIS, and MEDLINE (PubMed)

### .

<b>B</b> IOLOGICAL APPLICATIONS	
Gray-Level Co-Occurrence Matrix Texture Analysis of Breast Tumor Images in Prognosis of Distant Metastasis Risk Tijana Vujasinovic, Jelena Pribic, Ksenija Kanjer, Nebojsa T. Milosevic, Zorica Tomasevic, Zorka Milovanovic, Dragica Nikolic-Vukosavljevic, and Marko Radulovic	646
Gastro-Enteropancreatic Neuroendocrine Tumor Cell Dynamics in Liver Microvasculature	655
Priyodarshan Goswamee, Sasi Arunachalam, Saurabh Mehta, Riaz Nasim, William T. Gunning III, and David R. Giovannucci	
Collagen Fibrils and Proteoglycans of Macular Dystrophy Cornea: Ultrastructure and 3D Transmission Electron Tomography	666
Saeed Akhtar, Hind M. Alkatan, Omar Kirat, Adnan A. Khan, and Turki Almubrad Nanoscopic Localization of Surface-Exposed Antigens of Borrelia burgdorferi Leandro Lemgruber, Celso Sant'Anna, Caron Griffths, Yuri Abud, Musa Mhlanga, Reinhard Wallich, and Friedrich Frischknecht	680
Comparative Analysis of Root Dentin Morphology and Structure of Human Versus Bovine Primary Teeth Bruna M. Costa, Alexsandra S. Iwamoto, Regina M. Puppin-Rontani, and Fernanda M. Pascon	689
Localization of the Trace Elements Iron, Zinc, and Selenium in Relation to Anatomical Structures in Bovine Ovaries by X-Ray Fluorescence Imaging Melanie J. Ceko, Katja Hummitzsch, Wendy Bonner, Jade B. Aitken, Kathryn M. Spiers, Raymond J. Rodgers, and Hugh H. Harris	695
TECHNIQUES AND EQUIPMENT DEVELOPMENT	
When will Low-Contrast Features be Visible in a STEM X-Ray Spectrum Image? Chad M. Parish	706
Matched Backprojection Operator for Combined Scanning Transmission Electron Microscopy Tilt- and Focal Series Tim Dahmen, Holger Kohr, Niels de Jonge, and Philipp Slusallek	725
A Dictionary Approach to Electron Backscatter Diffraction Indexing Yu H. Chen, Se Un Park, Dennis Wei, Greg Newstadt, Michael Jackson, Jeff P. Simmons, Marc De Graef, and Alfred O. Hero	739
Monte Carlo Simulation of Characteristic Secondary Fluorescence in Electron Probe Microanalysis of Homogeneous Samples Using the Splitting Technique Mauricio Petaccia, Silvina Segui, and Gustavo Castellano	753
The Dark Side of EDX Tomography: Modeling Detector Shadowing to Aid 3D Elemental Signal Analysis Catriona S.M. Yeoh, David Rossouw, Zineb Saghi, Pierre Burdet, Rowan K. Leary, and Paul A. Midgley	759
Design and Application of Variable Temperature Setup for Scanning Electron Microscopy in Gases and Liquids at Ambient Conditions Ahmed S. Al-Asadi, Jie Zhang, Jianbo Li, Radislav A. Potyrailo, and Andrei Kolmakov	765
A Simple Metric for Determining Resolution in Optical, Ion, and Electron Microscope Images Alexandra E. Curtin, Ryan Skinner, and Aric W. Sanders	771
Liter Manking Description Full Field Deflection Trace Three Discoursional Apple	

High Vertical Resolution Full-Field Reflection-Type Three-Dimensional Angle-Deviation Microscope with Nonlinear Error Compensation Ming-Hung Chiu, Chen-Tai Tan, Shih-Feng Huang, and Jhao-An Chen

778

### **BOOK REVIEW**

Surface Microscopy with Low Energy Electrons	788
John C. H. Spence	

### TAKE A FRESH APPROACH TO SEM

Intuitive multi-touch screen interface • High spatial resolution • Unprecedented analytical versatility Easy navigation and operation • Fast imaging and data acquisition



Bring a whole new SEM experience to your lab with our InTouchScope series – designed to fit your budget and research applications.



www.jeolusa.com salesinfo@jeol.com • 978-535-5900

### www.jeolusa.com/fresh





### Isn't it about time you had your own Digital Microscope?

Now you can with the portable, affordable uScopeMXII!

The uScopeMXII is a small digital desktop microscope you can use in your workplace or home office. It captures images from standard glass slides and sends them to your PC.

You can interactively browse slides with full control of focus, image processing, and location. You can also scan regions of interest creating fully focused image sets.

The industry-standard USB interface makes it simple to plug in and start capturing images. It easily interfaces with your desktop or laptop PC and allows you to view and capture slide images in a wide variety of environments.

The uScopeMXII is manufactured in the United States.



Phone +1-214-785-2058 FAX +1-214-785-2138 Email sales@uscopes.com support@uscopes.com

Call us today for a quote or to schedule a demonstration

### www.uscopes.com



### Seamless integration for smart results

- EDS, EBSD and WDS seamlessly integrated with a single user interface
- Built-in Smart Features facilitate set-up, guide analysis and automate reporting
- Proven algorithms guarantee quality results
- Streamlined workflows drive productivity with fast and accurate results in three clicks

edax.com

• The ultimate solution for every materials analysis challenge



TRIDEN

TEAM EDS

TFAM

EBSD

TEAM" WDS



### Goodbye vacuum... Hello Atmosphere



### **Pressure and temperature with the microscope** Learn more about Atmosphere today at **www.protochips.com**





https://doi.org/10.1017/S1431927615013781 Published online by Cambridge University Press



Your small contamination is our big priority.





### CAMBRIDGE

### New to the Advances in Microscopy and Microanalysis book series!

### Scanning Electron Microscopy for the Life Sciences

Heide Schatten University of Missouri, Columbia US\$120.00: Hb: 978-0-521-19599-7: 312 pp

Recent developments in scanning electron microscopy (SEM) have resulted in a wealth of new applications for cell and molecular biology, as well as related biological

disciplines. It is now possible to analyze macromolecular complexes within their three-dimensional cellular microenvironment in near native states at high resolution, and to identify specific molecu les and their structural and molecular interactions. New approaches include cryo-SEM applications and environmental SEM (ESEM), staining techniques and processing applications combining embedding and resin-extraction for imaging with high resolution SEM, and advances in immuno-labeling. With chapters written by experts, this guide gives an overview of SEM and sample processing for SEM, and highlights several advances in cell and molecular biology that greatly benefited from using conventional, cryo, immuno, and high-resolution SEM.





### About the series

The Press currently publishes the Microscopy and Microanalysis (MAM) journal in conjunction with the MSA, which reaches 4,000 microscopists and is affiliated with 12 international microscopy societies. The series would be a natural development from this journal, and will take a broad view of the discipline, covering topics from instrumentation to imaging, methodology and analysis across physical science, materials science, biology and medicine. Books commissioned for the series will range from advanced undergraduate textbooks through to research and practitioner oriented monographs for researchers. The series aims to produce a coherent source of material, encouraging the communication and exchange of ideas across these divergent fields, ensuring that the series appeals to a broad community in the physical and life sciences.

### Forthcoming titles in this series:

#### **Microscopic Nanocharacterization of Materials** by Michael Isaacson

**Energy Filtered Electron Microscopy and Electron Spectroscopy** by Richard Leapman

**Dynamic Transmission Electron Microscopy** by Nigel Browning, Thomas LaGrange, Bryan Reed, Henning Stahlberg, Bradley Siwick



www.cambridge.org/us 800.872.7423



Visit the website often for details on Symposia, Exhibits, Biological and Physical Sciences Tutorials, In-Week Intensive Workshops, Posters, Sunday Short Courses and Pre-Meeting Congress!

# August 2-6 • Portland, OR

### http://microscopy.org/MandM/2015







Program Information | Information for Students | Meeting Awards | Exhibitor List & Floor Plan Online Registration (opens February 2015) | Portland Hotel Information (reservations available February 2015)









### 4 Techniques – 1 Workflow.

ESPRIT 2, the only software which combines 4 microanalysis methods.

- Comprehensive management of analysis and results from EDS, WDS, EBSD and Micro-XRF with one software
- Complementary techniques provide you the most accurate and reliable results
- Zeta factor quantification for characterization of thin layers

### Someone has to be first.



www.bruker.com/esprit2

### Innovation with Integrity

Software

https://doi.org/10.1017/S1431927615013781 Published online by Cambridge University Press

### THE NEW DESK V THE GOLD STANDARD IN SAMPLE PREPARATION



Now upgraded with storage for up to ten recipes and a color touch screen display, the Desk V HP delivers breakthrough electron microscopy sample preparation.

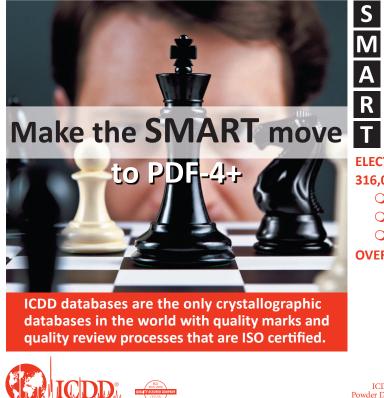
**DENTON** VACUUM

BARRIERS BECOME BREAKTHROUGHS

Visit us at: www.dentonvacuum.com/mt



### INTERNATIONAL CENTRE FOR DIFFRACTION DATA



Standardized data

More coverage

All data sets are evaluated for quality

Reviewed, edited and corrected prior to publication

Targeted for material identification and characterization

### ELECTRON DIFFRACTION SIMULATIONS ON OVER 316,000 ENTRIES

- **O** Electron Diffraction Powder Pattern
- **O** Interactive spot pattern display
- **O** Electron Diffraction Backscatter Pattern

**OVER 251,000 ENTRIES WITH ATOMIC COORDINATES** 





www.icdd.com | marketing@icdd.com

ICDD, the ICDD logo and PDF are registered in the U.S. Patent and Trademark Office. Powder Diffraction File is a trademark of JCPDS—International Centre for Diffraction Data. ©2015 JCPDS—International Centre for Diffraction Data.

### Your Field Emission SEMs for High Contrast, Low Voltage Images From Any Sample **ZEISS GeminiSEM Family**



With the ZEISS GeminiSEM family you get a flexible and reliable field emission SEM for your research, industrial lab or imaging facility. You always acquire excellent images from any real world sample. The GeminiSEM family stands for effortless imaging with sub-nanometer resolution and high detection efficiency, even in variable pressure mode. Contact us to schedule your demo at M&M 2015. Or visit the ZEISS booth to learn more.

M&M | August 3 - 6, 2015 | Booth #638

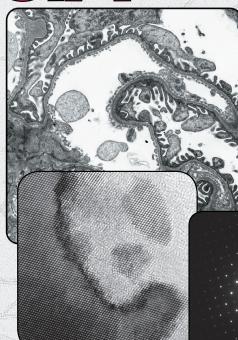


info.microscopy.us@zeiss.com www.zeiss.com/microscopy/mm



We make it visible.

### 1 TO 50 MEGAPIXELS live and slow scan MAGNIFICATION FACTOR OF 1 on bottom mounted cameras DIFFRACTION BEAM STOP on side mounted cameras







http://microscopy.org/MandM/2015

Affordable TEM camera systems for research, education, healthcare, and industry since 2001

Scientific Instruments and Applications 2773 Heath Lane • Duluth, GA 30096 (770) 232 7785 • www.sia-cam.com



Visit the website often for details on Symposia, Exhibits, Biological and Physical Sciences Tutorials, In-Week Intensive Workshops, Posters, Sunday Short Courses and Pre-Meeting Congress!

Program Information

Information for Students

Meeting Awards

Exhibitor List & Floor Plan

Online Registration (opens February 2015)

Portland Hotel Information (reservations available February 2015)





WALDEN PONT

2.530 Mi





GARDE

MUTARE

MICROANAL

August 2-6 • Portland, OR

### UNLEASH THE POWER OF NANDANALYSIS

### with our Ultrahigh Resolution Analytical FE SEM Series

JSM-7100F/LV • JSM-7100F T/LV • JSM-7610F • JSM-7800F/LV • JSM-7800F Prime

- Outstanding low kV/low vacuum performance
- Ultrahigh resolution imaging and nanoanalysis of structures, surface details, and magnetic samples
- Multi-port chamber allows in situ nanolab utility
- Ask us about the new JEOL soft X-ray emission spectrometer

Polycrystalline silicon specimen analyzed using EBSD and JEOL FE SEM



www.jeolusa.com salesinfo@jeol.com • 978-535-5900

JEOL



Learn more about the versatility and performance of this new generation of analytical SEMs.

Select the right SEM for your lab and budget from the JEOL FE SEM series.

### www.jeolusa.com/FESEM

### EMS has it! the latest technology for...

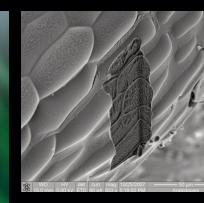
### **CRYO-SEM Preparation**

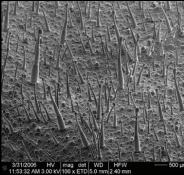


The PP3010T is a highly automated, easy-to-use, column-mounted, gas-cooled cryo preparation system suitable for most makes and models of SEM, FE-SEM and FIB/SEM. The PP3010T has all the facilities needed to rapidly freeze, process and transfer specimens.

Now, building on the success of the PP3010T cryo-SEM/FIB/SEM preparation system, we are pleased to announce three new related products for ambient and cryo temperature transfer...

### Electron Microscopy ciences







### See how it works... Learn how to do it...

We've added video content to our website to help you get to know our latest products even better!

Stop by and see what it's all about.



### **NOW AVAILABLE: NEW Specimen Transfer Systems**

**PP3005 SEMCool** 

beamline and vacuum platforms

Non-airlock cryo cooling for SEM, FIB/SEM,

### **PP3004 QuickLok**

Ambient temperature airlock for SEM, FIB/SEM, beamline and vacuum platforms



- Rapid specimen exchange
- Vacuum and inert gas transfer
- Field-retrofittable to most systems
- Upgrade path to CoolLok

0

doi.org/10.1017/S14

- Custom designed holders available
- 🗖 3 year warranty



- Temperature range down to -190°C, with stability better than 0.5°C
- Off-column cooling with all-day runtime between fills
- Independent cooling of cold stage and cold trap
- Upgrade path to CoolLok
- 3 year warranty

### **PP3006 CoolLok**

Cryo transfer systems for SEM, FIB/SEM, beamline and vacuum platforms



- Temperature range down to -190°C with stability better than 0.5°C
- Off-column cooling with all-day runtime between fills
- Independent cooling of cold stage and cold trap
- Vacuum or inert gas transfer

### **CONTACT US FOR MORE INFORMATION...**

### Electron Microscopy Sciences

P.O. Box 550 • 1560 Industry Rd. Hatfield. Pa 19440 Tel: (215) 412-8400 Fax: (215) 412-8450 email: sgkcck@aol.com or stacie@ems-secure.com

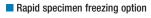
www.emsdiasum.com







- Rapid specimen exchange



3 year warranty

