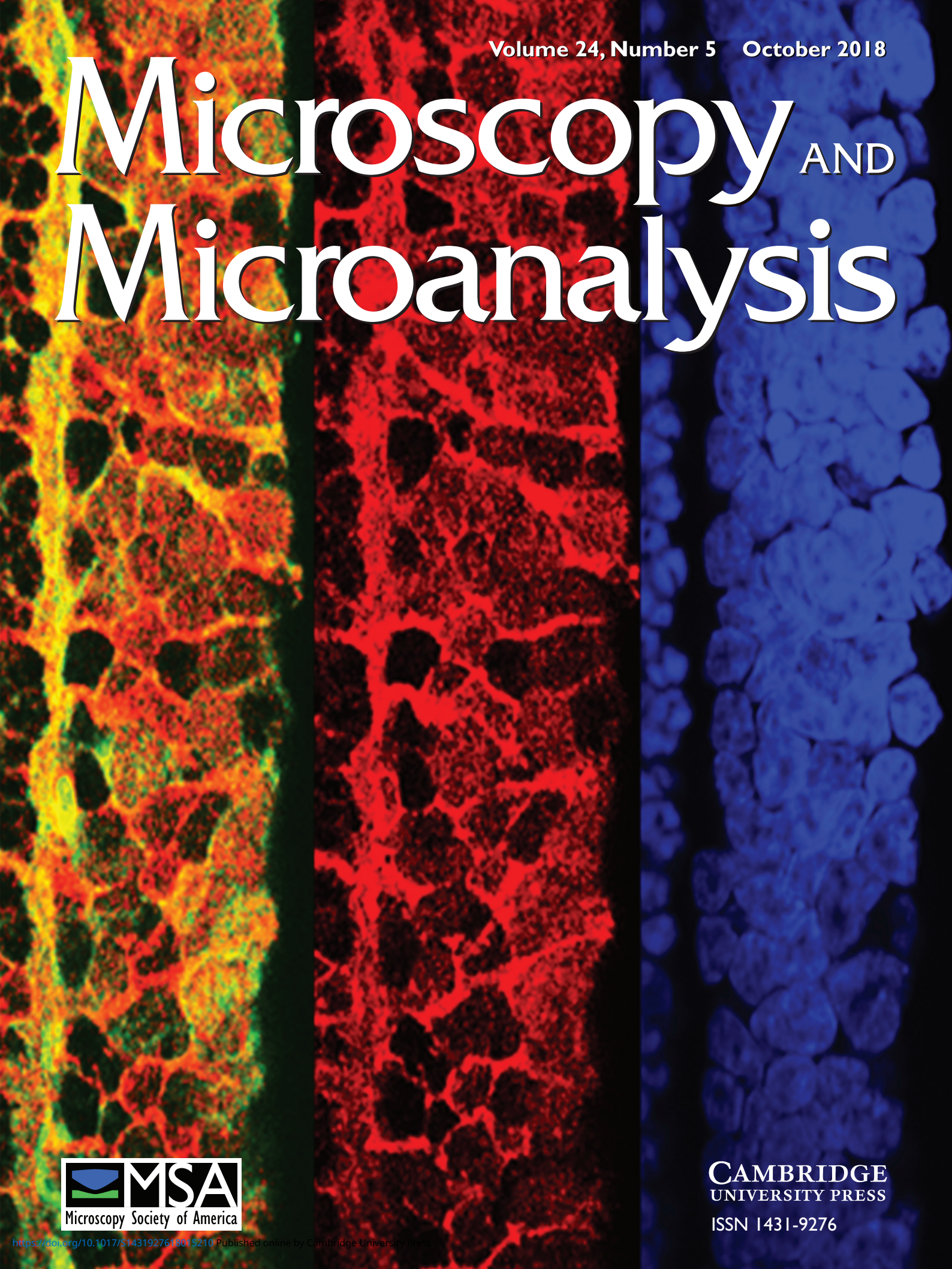
Volume 24, Number 5 October 2018

Microscopy AND Microanalysis



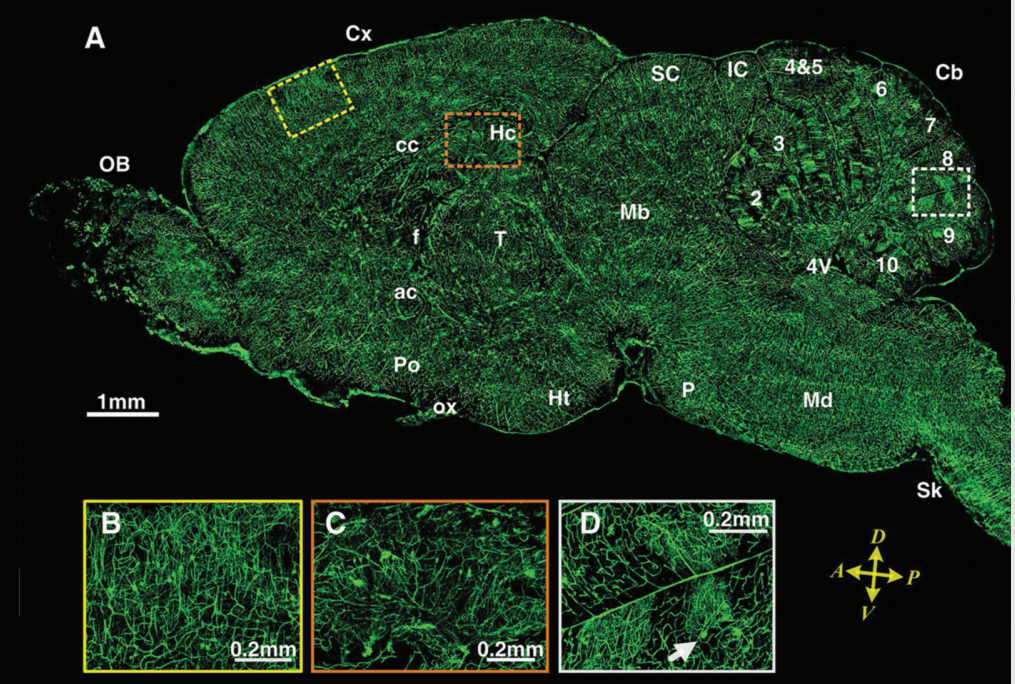
MSA Microscopy Society of America

CAMBRIDGE UNIVERSITY PRESS

ISSN 1431-9276

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

YOU'LL FIND **DiATOME** AT THE FOREFRONT OF **INNOVATION...**



Creating a High Resolution Atlas of the Mouse Brain...

(A) A sagittal image reconstructed from a stack of 100 virtual sagittal sections (total thickness of 0.1 mm). These sections were transformed from the original coronal sections. The sagittal image was located in the right hemisphere about 0.4 mm lateral to the middle. Almost all major regions of the brain can be seen in this image, e.g., the Olfactory Bulb (OB), Cerebral Cortex (Cx), Hippocampus (Hc), Fornix(f), Anterior Commissure (ac), Thalamus (T), Cerebellum (Cb), Midbrain (Mb), Pons (P), Medulla (Md), Corpus Callosum (cc), Superior Colliculus (SC), Inferior Colliculus (IC), Hypothalamus (Ht), Preoptic Area (Po), Optic Chiasm (ox), 4th ventricle (4V) and nine lobules of the cerebellum (Arabic numerals, 2 to 10). The three regions inside the different colored rectangle in (A) are the positions of (B), (C) and (D), which illustrate the cerebral cortex, hippocampus and cerebellum, respectively. In the reconstruction of sagittal image, no dislocation was observed along the D-V axis, i.e., the coronal sections are inherently aligned along the A-P axis.

https://doi.org/10.1017/S1431927618015210

DiATOME QUALITY AND INNOVATION APPLIED...

Micro-Optical Sectioning Tomography to Obtain a High-Resolution Atlas of the Mouse Brain

Existing imaging tools have limitations for brainwide mapping of neural circuits at a mesoscale level. In collaboration with DiATOME, researchers developed a Micro-Optical Sectioning Tomography (MOST) system utilizing a DiATOME Diamond Knife that can provide micron tomography of a centimeter-sized whole mouse brain.

Slicing was performed by moving the specimen to generate ribbons, and each ribbon was simultaneously imaged. The illuminating beam passed through a beam splitter, mirror and objective to irradiate the ribbon. The imaging beam collected by the objective and passed through the mirror, beam splitter and tube lens was then recorded by a line-scan CCD.

A 3D structural dataset of a Golgi-stained whole mouse brain at the neurite level was obtained. The morphology and spatial locations of neurons and traces of neurites were clearly distinguished. Researchers found that neighboring Purkinje cells were sticking to each other.

Acknowledgement

Micro-Optical Sectioning Tomography to Obtain a High-Resolution Atlas of the Mouse Brain Anan Li, Hui Gong, Bin Zhang, Qingdi Wang, Cheng Yan, Jingpeng Wu, Qian Liu, Shaoqun Zeng, Qingming Luo

Britton Chance Center for Biomedical Photonics, Wuhan National Laboratory for Optoelectronics–Huazhong University of Science and Technology, Wuhan 430074, P. R. China.

ACHIEVE **CUTTING EDGE** RESULTS WITH
DiATOME DIAMOND KNIVES

PLEASE CONTACT US FOR MORE INFORMATION...

DiATOME U.S.

P.O. Box 550 • 1560 Industry Rd.
Hatfield, PA 19440
Tel: (215) 412-8390 • Fax: (215) 412-8450
email: info@emsdiasum.com
or stacie@ems-secure.com

www.emsdiasum.com

follow us on...

Microscopy AND Microanalysis

An International Journal for the Biological and Physical Sciences

THE OFFICIAL JOURNAL OF

MICROSCOPY SOCIETY OF AMERICA
MICROANALYSIS SOCIETY
MICROSCOPICAL SOCIETY OF CANADA / SOCIÉTÉ DE MICROSCOPIE DU CANADA
MEXICAN MICROSCOPY SOCIETY
BRAZILIAN SOCIETY FOR MICROSCOPY AND MICROANALYSIS
VENEZUELAN SOCIETY OF ELECTRON MICROSCOPY
EUROPEAN MICROBEAM ANALYSIS SOCIETY
AUSTRALIAN MICROSCOPY AND MICROANALYSIS SOCIETY
PORTUGUESE SOCIETY FOR MICROSCOPY
ELECTRON MICROSCOPY SOCIETY OF INDIA

PUBLISHED IN AFFILIATION WITH

ROYAL MICROSCOPICAL SOCIETY
GERMAN SOCIETY FOR ELECTRON MICROSCOPY
BELGIAN SOCIETY FOR MICROSCOPY
MICROSCOPY SOCIETY OF SOUTHERN AFRICA

Editor-in-Chief
John Mansfield
4304 Spring Lake Blvd.
Ann Arbor, MI 48108-9657
e-mail: thejfmjfm@me.com

Administrative Editor
John Shields
University of Georgia
Athens, GA 30602
e-mail: jpshield@uga.edu

Biological Sciences Applications Editors
W. Gray (Jay) Jerome
Department of Pathology, Microbiology and Immunology
U-2206 MCN
Nashville, TN 37232-2561
e-mail: jay.jerome@vanderbilt.edu

Heide Schatten
Department of Veterinary Pathobiology
University of Missouri-Columbia
Columbia, MO 65211
e-mail: SchattenH@missouri.edu

Rosemary White
CSIRO Plant Industry
Canberra, ACT 2601, Australia
e-mail: Rosemary.white@csiro.au

Elizabeth Wright
Department of Pediatrics
School of Medicine
Emory University
Atlanta, GA 30322
e-mail: erwrigh@emory.edu

Cultural Heritage Applications Editor
Edward P. Vicenzi
Smithsonian Institution, Museum Conservation Institute
4210 Silver Hill Rd., Suitland, MD 20746
e-mail: VicenziE@si.edu

Materials Sciences Applications Editors
Vinayak Dravid
Materials Science and Engineering
Northwestern University
Evanston, IL 60208-3105
e-mail: v-dravid@nortwestern.edu

Georg E. Fantner
Interfaculty Institute for Bioengineering
École Polytechnique Fédéral de Lausanne
Lausanne 1015, Switzerland
e-mail: georg.fantner@epfl.ch

David J. Larson
CAMECA
5500 Nobel Drive
Madison, WI 53711
e-mail: david.larson@ametek.com

Ian MacLaren
Materials and Condensed Matter Physics
School of Physics and Astronomy
University of Glasgow
Glasgow G12 8QQ, UK
e-mail: Ian.MacLaren@glasgow.ac.uk

Ross Marceau
Institute for Frontier Materials
Deakin University
Geelong, VIC 3216, Australia
e-mail: r.marceau@deakin.edu.au

Joseph Michael
Sandia National Laboratories
P.O. Box 5800, Albuquerque, NM 87185
e-mail: jrmicha@sandia.gov

Yoosuf N. Picard
Materials Science & Engineering
Carnegie Mellon University
Pittsburgh, PA 15213
e-mail: ypicard@cmu.edu

Masashi Watanabe
Dept. of Mater. Sci. & Eng.
Lehigh University, Bethlehem, PA 18015
e-mail: masashi.watanabe@lehigh.edu

Special Issues and Reviews Editor
David J. Smith
Department of Physics
Arizona State University, Tempe, AZ 85287-1504
e-mail: david.smith@asu.edu

Book Review Editor
Cynthia Goldsmith
Centers for Disease Control, Atlanta, GA 30333
e-mail: csg1@cdc.gov

***M&M Program Guide* Editor**
Richard L. Martens
1013 Bevill Building
Box 870164, Tuscaloosa, AL 35487-0164
e-mail: rmartens@caf.ua.edu

***Proceedings* Editor**
Gail Celio
University of Minnesota, St. Paul, MN 55108
e-mail: celio001@umn.edu

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

Microscopy AND Microanalysis

© MICROSCOPY SOCIETY OF AMERICA 2018

Editorial Board

Ralph Albrecht	*University of Wisconsin, Madison, Wisconsin*
Ilke Arslan	*Pacific Northwest Laboratory, Richland, Washington*
Mary Grace Burke	*University of Manchester, Manchester, UK*
Barry Carter	*University of Connecticut, Storrs, Connecticut*
Wah Chiu	*Baylor College of Medicine, Houston, Texas*
Marc De Graef	*Carnegie Mellon University, Pittsburgh, Pennsylvania*
Niels de Jonge	*INM Institute for New Materials, Saarbrücken, Germany*
Elizabeth Dickey	*North Carolina State University, Raleigh*
Mark Ellisman	*University of California at San Diego, San Diego, California*
Pratibha Gai	*University of York, United Kingdom*
Marija Gajdardziska-Josifovska	*University of Wisconsin-Milwaukee, Milwaukee, Wisconsin*
Paul Kotula	*Sandia National Labs, Albuquerque, New Mexico*
William Landis	*University of Akron, Akron, Ohio*
Charles Lyman	*Lehigh University, Bethlehem, Pennsylvania*
Dale Newbury	*National Institute of Standards and Technology, Gaithersburg, Maryland*
Robert Price	*University of South Carolina, Columbia, South Carolina*
Jean-Paul Revel	*California Institute of Technology, Pasadena, California*
David Smith	*Arizona State University, Tempe, Arizona*
Nan Yao	*Princeton University, Princeton, New Jersey*
Nestor Zaluzec	*Argonne National Laboratory, Argonne, Illinois*

Editorial Board Representatives from Affiliated Societies

Donovan Leonard	*Oak Ridge National Laboratory (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*
Robert L. Price	*University of South Carolina, Columbia, South Carolina*

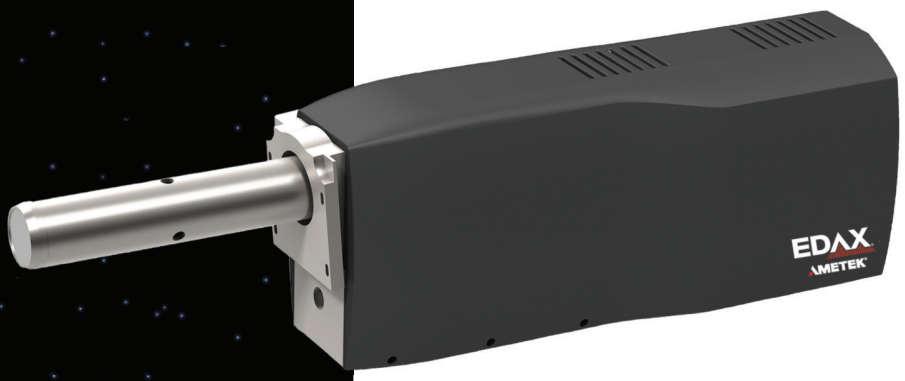
This journal is part of the **Cambridge Core** service. Access to online tables of contents and article abstracts is available to all researchers at no cost. Access to full-text articles online is provided to those with online subscription. Online subscriptions must be activated. Once your subscription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

***Microscopy and Microanalysis* website: cambridge.org/MAM.**

Instructions for authors submitting manuscripts may be found at cambridge.org/MAM. Select "Further Information" then select "Instructions for Contributors."

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

The velocity for stellar results



Introducing the Velocity™ EBSD Camera

The EDAX Velocity™ EBSD camera offers high-speed EBSD mapping with the highest indexing performance for all materials. Powered by a CMOS sensor, the Velocity™ camera combines fast acquisition with high sensitivity and low noise performance for optimal data collection and quality results.

- CMOS low-noise sensor
- > 3000 indexed points per second
- High-speed simultaneous EDS-EBSD collection
- 120 x 120 pixel images at high speeds
- Accurate and precise data on real-world samples

For more information about the Velocity™ EBSD camera please visit edax.com/velocity

AMETEK®
MATERIALS ANALYSIS DIVISION

edax.com

EDAX®
Smart Insight

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

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 cambridge.org/mam, select "Information," and then select "Instructions for Contributors."

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 holder 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.

Aims and Scope

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, 11130 Sunrise Valley Dr, Suite 350, Reston, VA 20191, Tel.: (703) 234-4115, Email: associationmanagement@microscopy.org, URL: www.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 $2364.00 in the USA, Canada, and Mexico; UK £1422.00 + VAT elsewhere. Institutions online only: US $1533.00 in the USA, Canada, and Mexico; UK £928.00 + VAT elsewhere. Individuals print plus online: US $691.00 in the USA, Canada, and Mexico; UK £420.00 + 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), 1 Liberty Plaza, New York, NY 10006, 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, University Printing House, Shaftesbury Road, Cambridge CB2 8BS, 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

John Mansfield, Editor in Chief, 4304 Spring Lake Blvd., Ann Arbor, MI 48108-9657, USA; Tel: (734) 994-3096; Fax: (734) 763-2282; E-mail: thejfmjfm@me.com.

Office of Publication

Cambridge University Press, 1 Liberty Plaza, New York, NY 10006, 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.

© 2018 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, 1 Liberty Plaza, New York, NY 10006.

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

TESCAN MIRA3

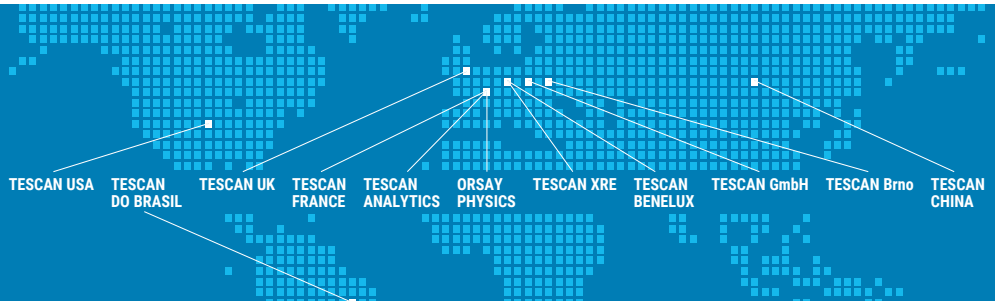
Simplicity and Flexibility that Matters

The affordable Field-Emission Electron Microscope
That Does Not Compromise

- **Navigate across the sample,** wide-field electron imaging enables observation of features to locate and analyze failure locations easily and efficiently
- **Take imaging to the next level,** with powerful in-beam detection system for extraordinary image quality
- **Extend the performance** at low-beam energies with beam deceleration for ultimate surface sensitivity
- **TESCAN software that is compatible** with future Microsoft operating systems, meaning no costly computer upgrades

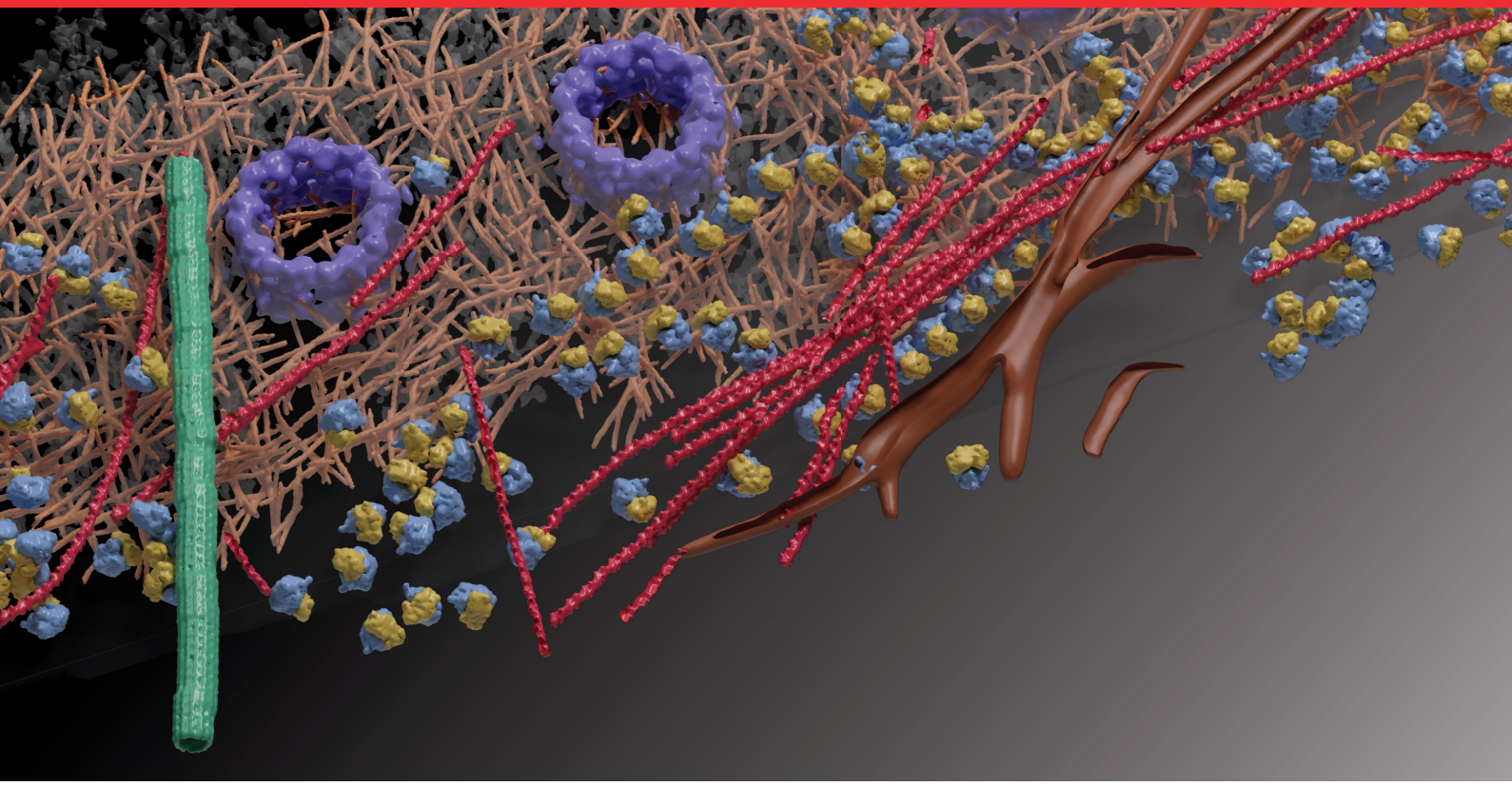
For more information visit
www.tescan.com

TESCAN
PERFORMANCE IN NANOSPACE



Published online by Cambridge University Press

thermoscientific



Cryo-electron tomography reveals the molecular organization of various components of the HeLa cell their natural environment. Data courtesy of Dr. J. Mahamid, Department of Molecular Structural Biology, Max Planck Institute for Biochemistry, Martinsried, Germany.

Prepare Lamellas for Cryo-electron Tomography

The Thermo Scientific™ Aquilos™ Cryo-FIB is the first cryo-DualBeam™ (focused ion beam/scanning electron microscope) system dedicated to preparation of frozen, thin lamella samples from biological specimens for high-resolution tomographic imaging in a cryo-transmission electron microscope (cryo-TEM). Cryo-electron tomography's ability to visualize structures in their native context allows researchers to observe functional relationships and interactions with other components in the cellular environment. This technique promises to become an important tool for scientists seeking a better understanding of living systems at the molecular level.

Find out more at **thermofisher.com/EM-life-sciences**

ThermoFisher SCIENTIFIC

© 2018 Thermo Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific and its subsidiaries unless otherwise specified.

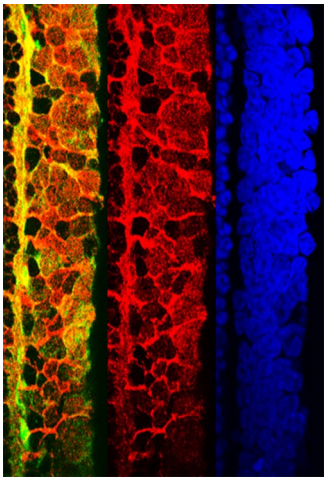
https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

Microscopy AND Microanalysis

An International Journal for the Biological and Physical Sciences

Volume 24, Number 5

October 2018



On the Cover: Müller glial cells, apart from their role in the maintenance and function of neuronal cells, have been described as living light fibers that help to trap and conduct light from their endfeet directly to the photoreceptor cells (Franze et al., 2007; Agte et al., 2011; Zueva et al., 2014; Agte et al., 2018). Therefore, in the retina, light transport is not only be facilitated by its transparency, but by the direct transport through the cell body of Müller cells. Localizing αA-crystallin within Müller cells could mean that QJ; αA-crystallins, as in other highly transparent cells, allow minimizing intraretinal scattering during retinal light transmission and help to promote retinal tissue transparency. Legend: Expression of nuclear staining 4′,6-diamidino-2-phenylindole (DAPI) in blue, glial marker GS in red, and merging of αA-crystallin (green) and GS (red) in the inner nuclear layer of the rat retina. From paper by Zayas-Santiago et al, pp. 545–552.

***Microscopy and Microanalysis* website: http://www.cambridge.org/MAM**

Indexed in Chemical Abstracts, Current Contents, BIOSIS, and MEDLINE (PubMed)

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

Micrographia

Corrigendum

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

Expanding the imaging range with only one microscope.

ZEISS LSM 800

// PRECISION
MADE BY ZEISS

Visit us in Booth #310 at MRS Fall

Your versatile confocal microscope for materials research and failure analysis

Expand your imaging range. ZEISS LSM 800 is the one instrument you will need for materials analysis. Characterize 3D surfaces precisely. With no need to change microscopes, you'll save time on set-up. Combine light microscopical and confocal imaging for your 3D analyses.

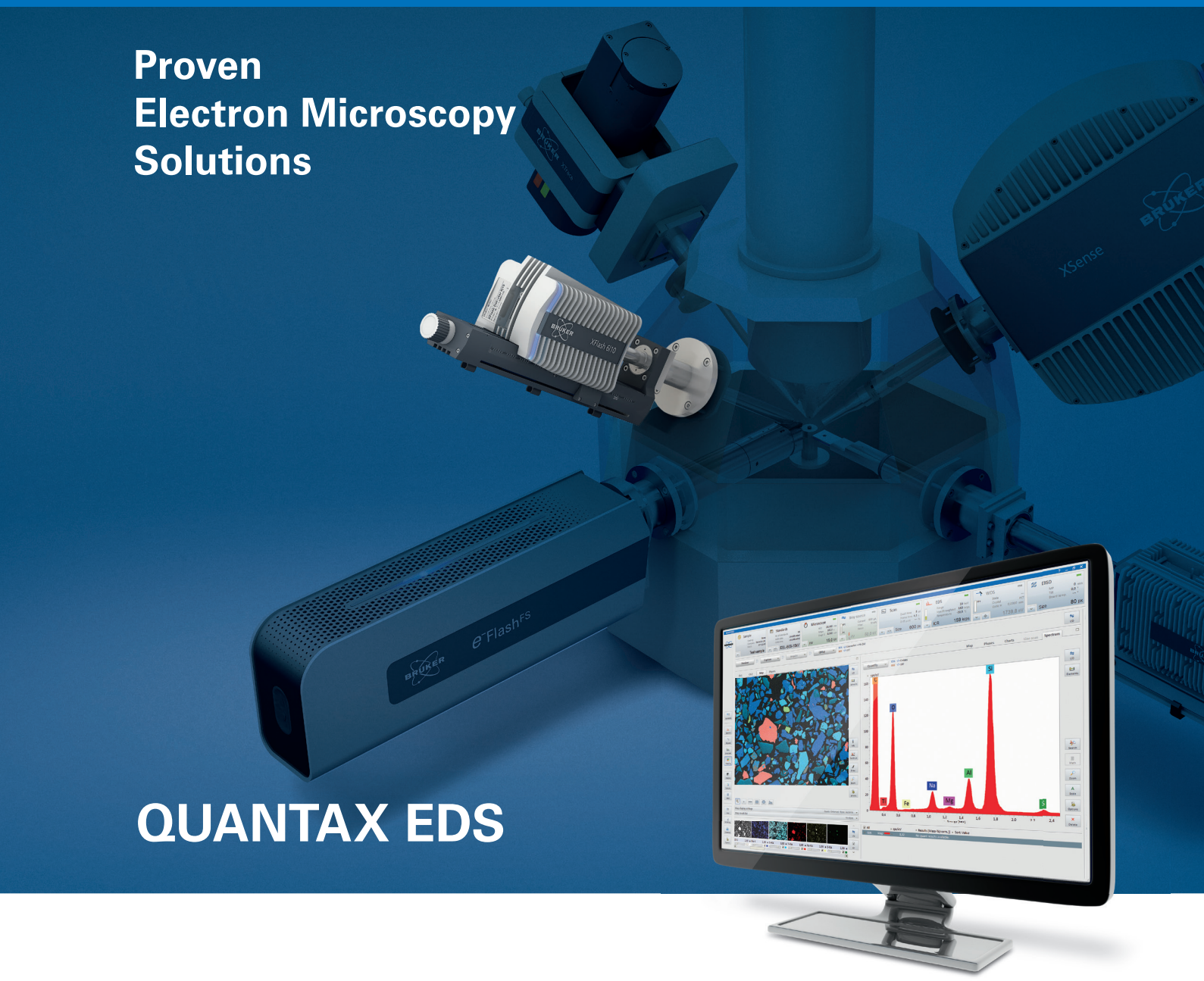
www.zeiss.com/lsm800-mat

ZEISS

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press

BRUKER

Proven Electron Microscopy Solutions



QUANTAX EDS

- Featuring XFlash® 6 – worldwide leading SDD technology for SEM and TEM
- Delivering the fastest, most accurate EDS results
- Easiest-to-use EDS, available in configurations for every budget
- Integration of EDS, WDS, EBSD and Micro-XRF on SEM under a single user interface

www.bruker.com/quantax

EDS

Innovation with Integrity

https://doi.org/10.1017/S1431927618015210 Published online by Cambridge University Press