



(/MandM/2016/)

## Microscopy & Microanalysis 2016 Meeting

M&M 2016 will be held July 24-28, 2016 at the **Columbus Convention Center** (<https://www.columbusconventions.com/>) in **Columbus, Ohio** (<http://www.experiencecolumbus.com/>).

The full **M&M 2016 SCIENTIFIC PROGRAM** ([/MandM/2016/program/Scientific\\_Program.pdf](/MandM/2016/program/Scientific_Program.pdf)) is now available!

Paper Submission Site is NOW CLOSED. We look forward to seeing your work at M&M 2017 in St. Louis. **Post-Deadline Poster** ([/MandM/2016/program/postdeadline\\_posters.cfm](/MandM/2016/program/postdeadline_posters.cfm)) slots are also available.

Check back often for updates and new information!

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### Dear Fellow Microscopists, Colleagues, and Friends:

On behalf of the sponsoring societies, we invite you to join us **July 24-28** in Columbus, Ohio for **Microscopy & Microanalysis 2016**. Columbus is the capital of Ohio, and is a vibrant, bustling city with great restaurants, fun nightspots, an up-and-coming culinary scene, and is a great family-friendly place to visit!

Participating at M&M 2016 will allow you to stay abreast of new technologies, learn new techniques, see the latest instrumentation, and most importantly, network with colleagues and make new connections. We hope that you will be able to join us in Columbus for what is certain to be a very exciting and educational meeting.

Mike Marko  
President  
Microscopy Society of America

Thomas F. Kelly  
President  
Microanalysis Society

Jaret Frafjord  
President  
International Metallographic Society

[Registration Information \(/MandM/2016/registration/fees.cfm\)](/MandM/2016/registration/fees.cfm)

[Full Scientific Program \(/MandM/2016/program/Scientific\\_Program.pdf\)](/MandM/2016/program/Scientific_Program.pdf)



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## Full Symposium Descriptions

- Biological Sciences Symposia
- Physical Sciences Symposia
- Analytical Sciences Symposia

### Biological Sciences Symposia

#### B01 Nanostructured Scaffolds for Regenerative Medicine

**Organizers:** *Marco C. Bottino, Caroline A. Miller*

The principles of tissue engineering for regeneration involve the combination and interplay of three major elements such as scaffolds, stem cells, and cell signaling molecules. Advances in the science and technology of nanomaterials have led to increased enthusiasm for approaches such as electrospinning of nanofibers. In recent years, regenerative medicine has changed the therapeutics of a wide range of diseases. The symposium will bring materials scientists, chemical/biomedical engineers, cell biologists, and clinician-scientists that will provide research evidence on the major areas relevant to nanostructured scaffolds development for regenerative medicine. Our goal is to stimulate discussion of the latest research approaches and technologies that will help propose future directions targeting clinical use.

**Invited Speakers:**

- Susan Bellis, University of Alabama – Birmingham
- Marco Bottino, Indiana University

#### B02 New Technologies for Digital Pathology

**Organizers:** *Rohit Bhargava, David Mayerich*

A wealth of technologies is changing the traditional approach of careful sample preparation, staining and manual recognition with light microscopy. New instrumentation for microscopy in different spectral regions, recognition algorithms and imaginative new applications are merging in emerging digital pathology applications that promises more effective medical care and decision-making. This symposium will explore the multifaceted activities related to microscopy for digital pathology. Experts will describe cutting edge research in all three areas, with emphasis on innovative new solutions to traditional problems in pathology.

**Invited Speakers:**

- Anant Madabhushi, Case Western Reserve University
- Metin Gurcan, The Ohio State University
- Richard Levenson, UC Davis Health System

## B03: Super-resolution Visualization of Cellular and Inter-Cellular Processes in Health and Disease

### ***Organizer: Rob Gourdie***

The 2014 Nobel prize was awarded to Eric Betzig, W.E. Moerner and Stefan Hell for the development of super-resolved fluorescence microscopy, which has enabled imaging of cellular nanostructure at resolutions an order of magnitude below the Abbe limit of 200 nm. Super-resolution microscopy shifts the paradigm – with an impact on the field of cell biology comparable to the advent of laser scanning confocal microscopy or electron microscopy. In our session we aim to cover examples of the application of both stochastic (e.g., PALM, STORM) and deterministic (e.g., STED, SSIM) super-resolution technologies, to study homeostatic and diseased cells at the nanoscale.

### ***Invited Speakers***

- Eli Rothenberg, New York University
- James Smyth, Virginia Polytechnic Institute
- Mike Koval, Emory University

## B04 Microscopy and Morphogenesis

### ***Organizers: Rich Goodwin, Jay Potts***

Despite centuries of investigation, how biological organisms grow and develop specific shapes, colors, and structures is largely unknown. Yet, it is critically important for the continuity of life that certain shapes and structures be constructed in a precise and reproducible fashion. A fundamental problem facing investigation of the morphogenesis is the temporal and spatial resolution necessary to observe growing and differentiating cells over extended periods of time. The advent of new imaging and analytical tools promises to shed light on the cellular and molecular processes that drive the development of biological forms. This session will focus on how these new technologies are answering long held questions.

### ***Invited Speakers***

- Sai Veeraraghavan, Virginia Polytechnic Institute
- Joy Lincoln, Nationwide Children's Hospital
- Bruce Gao, Clemson University
- Han Han, University of South Carolina
- Logan Hsu, Baylor University
- David Bader, Vanderbilt University

## B05 Pathology: When Normal Goes Wrong

### ***Organizers: Jay Jerome, Bill Gunning***

Pathological situations are just those in which the homeostatic balance becomes disrupted outside of the range of cells, tissues or organs to compensate effectively. This puts the organism in jeopardy. In this session, we will explore the underlying mechanisms of known homeostatic disruptions occurring in specific disease states, the

consequences of the disruptions and possible therapies to restore balance. Although we will explore individual disease states we hope to highlight the commonality of certain disruptions across diseases to encourage cross-discipline discussion.

### ***Invited Speakers***

- Andrea Kalinoski, University of Toledo
- Ramya Chandrasekaran, Vanderbilt University
- Jay Potts, University of South Carolina
- Jay Jerome, Vanderbilt University

## **B06 Pharmaceuticals and Medical Science**

### ***Organizers: John Bruce Green, Bridget Carragher***

This symposium will cover diverse content related to the research, development, manufacturing and use of both pharmaceuticals and medical products. It will include discussions of new approaches to the characterization and understanding of pharmaceuticals as well as detailed case studies. These presentations will generally address the unique challenges related to drug discovery, vaccine research, formulation, biocompatibility, production, product life cycle, medical product implementation, regulatory issues, and eventual patient use. Research topics may include any of the instruments and methods found at the exposition, ranging from microCT for whole device imaging right down to high-resolution TEM for structural biology of vaccines.

### ***Invited Speakers***

- Claudio Ciferri, Genentech
- Anette Schneemann, Nanoimaging Services
- Sachin Attavar, EAG
- Marcus Cicerone, NIST
- Jim Slipeka, Baxter
- Frank Platek, FDA
- Scott Aldrich, Ultramikro
- Joe Neilly, Abbvie

## **B07 3D Structures of Macromolecular Assemblies, Cellular Organelles and Whole Cells**

### ***Organizers: Elizabeth R. Wright, Teresa Ruiz, Kristin N. Parent***

Our understanding of the 3D structure and functional subtleties of cells, microorganisms and macromolecular assemblies has experienced great advances through recent developments of EM techniques and hybrid methodologies. This symposium will highlight structural and ultrastructural studies of cells, microorganisms and macromolecules using a variety of structural and hybrid techniques including electron tomography; electron crystallography; single-particle EM analysis; EM helical reconstruction; scanning and transmission electron microscopy; atomic force microscopy, X-ray crystallography, and modeling. Topics will include: eukaryotic and prokaryotic architecture; cellular metabolism; cell division and protein translation; cellular secretion, adhesion and motility; cell-cell communication and signaling; virus structure and virus-host interactions and all aspects of structure and function of macromolecular assemblies.

### ***Invited Speakers***

- Maryann Martone, University of California, San Diego
- Kenneth Taylor, Florida State University

- Vera Moiseenkova-Bell, Case Western Reserve University
- Reza Khayat, The City College of New York
- Tanmay Bharat, MRC Laboratory of Molecular Biology

## B08 Utilizing Microscopy for Research and Diagnosis of Diseases in Humans, Plants and Animals

**Organizers:** *Jon Charlesworth, Greg Ning, Betty Thompkins, Caroline Miller*

Microscopy is not only useful but also critically important in the ongoing research, detection, diagnosis and treatment of disease. Advances that improve rapid and accurate detection and treatment often involve the use of various microscopic techniques. These varied techniques provide us with an improved ability to diagnose and research the origins, development and response of diseases in human, plant and animal specimens. This is an opportunity to share information on the investigation of pathogenic cells, tissues and entire organisms in clinical, diagnostic and research laboratories. Emphasis will be placed on using latest microscopy in both clinical and research laboratories.

### **Invited Speakers**

- Rachel Cianciolo, Ohio State University
- Ryan Goffredi, Children's Hospital Colorado

[Back to top](#)

## Physical Sciences Symposia

### P01 Dr. Gareth Thomas Symposium: Materials Solutions through Microscopy

**Organizers:** *David B. Williams, Ron Gronsky*

Gareth Thomas was primarily responsible for the growth of transmission electron microscopy to become the characterization tool for materials in the USA and around the world. Building on a large group of graduate students, post docs and international collaborators at UC Berkeley for almost 50 years from 1959 until the early 2000s, his ideas and his students diffused throughout the world of TEM. Together they transformed the TEM from a physics-based instrument for the study of electron scattering into a practical tool for the complete characterization of the physical, chemical, mechanical, electrical and magnetic properties of crystalline materials. Many of the early fundamental studies of phase transformations and defects in crystalline materials can be traced to Gareth' influence: aluminum and Ni-base alloys and steels, through silicon-based ceramics, superconductors and magnetic materials. Gareth's single-minded focus on creating the National Center for Electron Microscopy introduced many materials scientist to the need for thinking BIG about the future of the field. He was among the first electron microscopists to take a university leadership position, acting as vice chancellor for student affairs at Berkeley during the troubled times around 1970. He was among the first to understand the need to commercialize some of our discoveries, starting companies based on his own research. In so many areas Gareth was ahead of his time and this symposium will gather many of his former students and what's left of his contemporaries to honor his achievements by showing how his influence continues to transform the combined fields of materials science and transmission electron microscopy.

### P02 Electron Microscopy of Materials for Electrochemical Power Systems

**Organizers: Mark Aindow, Karren L. More**

This symposium will highlight the roles of electron microscopy imaging, diffraction, and spectrometry in studies of materials, components, and devices for electrochemical power systems. There are many different types of electrochemical systems; each of these presents its own materials-related technological challenges, and microscopy is an essential tool for elucidating the materials degradation mechanisms and for developing new materials with significantly enhanced stability, durability, and performance. Contributions are welcome in the areas of energy materials, such as electrocatalysts and catalyst supports, electrolytes, electrodes, interconnects and seals, as well as membrane electrode assemblies and complete cells/stacks. Several sessions will emphasize the microscopic and spectroscopic techniques used to study component materials and aging phenomena, whereas others will be devoted to particular types of materials and cell technologies, including materials optimization and new materials development.

**Invited Speakers**

- Quentin Jeangros, EPFL, Switzerland
- Laure Guétaz, CEA, France
- Scott A. Barnett, Northwestern University
- C. Barry Carter, University of Connecticut
- David A. Cullen, Oak Ridge National Laboratory
- Paulo J. Ferreira, University of Texas, Austin
- Adam P. Hitchcock, McMaster University, Canada
- Christopher J. Kiely, Lehigh University
- Shirley Meng, University of California, San Diego
- Dean J. Miller, Argonne National Laboratory
- Megan Holtz, Cornell University

## P03 Combining Simulation, Experiment, and Data Science for Materials Characterization and Design

**Organizers: Paul Voyles, Jinwoo Hwang, Mark Oxley**

Simulation of complex electron scattering phenomena is an essential tool for understanding microscopy data, which in turn provide essential constraints on materials simulations such as density functional theory and molecular dynamics. This symposium will cover advances in simulation methods and new discoveries enabled by combining simulations and experiments. It will also include application of methods from data science, including machine learning and image processing, that enable automated, quantitative analysis of microscopy data and simulations, and the use of microscopy to inform simulation-aided materials design in the spirit of the Materials Genome Initiative.

**Invited Speakers**

- Benjamin Berkels, RWTH Aachen University, Germany
- Andreas Thust, Ernst Ruska Center, Germany
- James LeBeau, North Carolina State University
- Matthew Weyland, Monash University, Australia
- James Ciston, Lawrence Berkeley Laboratory
- John Rehr, University of Washington
- Christian Dwyer, Arizona State University
- Bryan Esser, The Ohio State University
- Sergei Kalinin, Oak Ridge National Laboratory

## P04 Nuclear and Irradiated Materials

**Organizers:** *Chad M. Parish, Khalid Hattar, Peter Hosemann*

Materials in fission, fusion, accelerator, or space environments are subjected to irradiation and can undergo significant compositional and structural evolution as a result. Because damage cascades and transmutation are atomistic processes, understanding and predicting the changes in properties and performance in radiation environments require atomistic and microstructural tools. Radiation environments vary from cryogenic temperatures, high energy, and low flux environments often found in space applications, to neutron damage of liquid helium-cooled superconductors and 1200°C tungsten under helium and neutron bombardment in a fusion reactor. Modern microscopy and microanalysis tools provide the means to study not only the smallest defects at the atomic scale, but also the real-time evolution of radiation damage. Coupling these techniques with modeling can enable the understanding to be extended from nm through mm or larger. This symposium aims to bring together instrumentation, modelling, and applications expertise to advance the science of materials for radiation environments.

### **Invited Speakers**

- Samuel Briggs, University of Wisconsin
- Bai Cui, University of Nebraska - Lincoln
- Janelle Wharry, Purdue University
- Jonathan Hinks, University of Huddersfield, UK
- Shen Dillon, University of Illinois

## P05 Microscopy for Thin Films of Metals, Semiconductors, and Insulators

**Organizers:** *Laxmikant V. Saraf, C. Barry Carter*

This symposium will emphasize advances in S/TEM especially when linked to other microscopies, as applied to metal, semiconductor and insulator (i.e., inorganic) thin films. Defects in thin films, whether single-layer or multi-layer stacks, epitaxial (epitactic) or polycrystalline, must be characterized by combining analytical tools. Defects determine the physical and chemical properties in most thin films and thus control materials performance. This symposium will cover all aspects of microscopy-based characterization of thin films produced using MBE, CVD, and other methods, including sputter deposition (DC/RF), evaporation, physical vapor deposition, e-beam evaporation, PLD, ALD, and . Comparable studies of thin-film growth using techniques suitable for deposition in other environments, such as sol-gel, dip-coating, casting, spray pyrolysis and exfoliation processes are solicited. Studies that use in situ or operando methods, or that combine different microscopies, are particularly encouraged. Applications of such studies include all aspects of detector/sensor technologies and development of alternative energy technologies.

### **Invited Speakers**

- Roberto Myers, The Ohio State University
- Donovan Leonard, Oak Ridge National Laboratory
- Katherine Jungjohann, Sandia National Laboratories
- Vinayak Draid, Northwestern University

## P06 Magnetic Materials, Phenomena and Imaging at the Nanoscale

**Organizers:** *Marc De Graef, Amanda Petford-Long*

A full understanding of bulk and nanoscale magnetic materials requires local probes that explore the magnetic structure and its response to applied fields/temperature at appropriate length scales, and that correlate this



with microstructure and chemistry. Suitable techniques include Lorentz TEM (including differential phase contrast, holography, and other phase reconstruction methods), electron energy loss spectroscopy, dichroism techniques (including vortex beam studies), magnetic force microscopy, and spin-polarized STM. The symposium goal is to bring together experimentalists involved in applying/developing these techniques, in addition to those involved in image simulations or the development of theory to explain quantitatively the observed magnetic contrast.

#### ***Invited Speakers***

- Charudatta Phatak, Argonne National Laboratory
- Daniel Wolf, University of Dresden, Germany
- Peter Fischer, Lawrence Berkeley National Laboratory
- Shane White, The Ohio State University
- Aditya Mohan, Purdue University

## **P07 Failure Analysis Applications of Microanalysis, Microscopy, Metallography and Fractography**

#### ***Organizers: Daniel P. Dennies, Noah Budiansky***

This symposium is intended to be a forum for the exchange of information and knowledge regarding the use of microanalysis, microscopy, metallography and fractography in materials-related failure analysis. Invited papers would include those involving failure investigations where microstructures, metallography and fractography are critical to identifying the root cause. Of particular interest are unique, innovative, and/or challenging applications of microscopy, metallography, fractography, and sample preparation in failure analysis. Target attendees will include engineers and scientists from all levels of analytical expertise and all related backgrounds, not just materials engineers.

#### ***Invited Speakers***

- Paul Ledwith, Exponent - Failure Analysis Associates
- William Lenthe, University of California, Santa Barbara
- Shari Rosenbloom, Corrosion Testing Laboratories, Inc.

## **P08 Microscopy of Additive Manufacturing and 3D Printing in Materials and Biology**

#### ***Organizers: Manuel Garcia-Leiner, Daniel P. Dennies, Michael Yost***

Additive manufacturing/3D printing encompasses multiple methods for building parts directly from feedstock such as powders, filaments, wires, and biomaterials with only minimal or no post build machining to produce a final shape. Resultant microstructures can be unique to the process and properties can be strongly dependent on such microstructures. In recent years, technologies have been developed for the additive manufacturing of polymers, metals, ceramics and biomaterials. In general, processes include powder-based fusion processes as well as extrusion or spray processes for the design of complex, highly functional parts. These days, additive manufacturing techniques are introduced to highly demanding, and highly specialized applications. More recently, biological and medical opportunities have sprung up taking advantage of 3D bio-printing. Implantable devices, heart valves, blood vessels and whole organs have begun to be manufactured. Each of these processes brings unique challenges to build parts and tissues that meet specifications and biocompatibility. Papers will highlight additive manufacturing and 3D printing in all areas of science from metals, polymers and ceramics to specific developments in biology and medicine.

#### ***Invited Speakers***

- John Porter, UES, Inc.

- Noah Budiansky, Exponent
- Ying Mei, Clemson University
- Mark Aubart, Arkema Inc.

## P09 From Angstrom to AU: Studies of Planet-Forming Materials

**Organizers:** *Eve L. Berger, Francis M. McCubbin, Adrian J. Brearley*

Micro- and nano-scale analyses of planetary materials (e.g., meteorites, IDPs, asteroidal and Lunar return samples, and experimental and terrestrial analogs) inform our understanding of our solar system's history. With the development of new techniques and novel implementations (EPMA, EELS, EDS, SIMS, FTIR, APT, EBSD, XCT, microscale geochronology, etc.) we further maximize the information gleaned from small-sample analyses. This meeting will report current research milestones gained through the use of these techniques, both individually and as part of coordinated analyses of planetary materials.

### **Invited Speakers**

- Jessica Barnes, Open University, UK
- Juliane Gross, Rutgers University
- Philipp Heck, The Field Museum
- Martin Lee, University of Glasgow, UK
- Laurent Remusat, Museum National d'Histoire Naturelle, France
- Adam Sarafian, Woods Hole Oceanographic Institute/MIT
- Shirin Kaboli, University of Nevada Las Vegas

## P10 Microscopy and Characterization of Ceramics, Polymers and Composites

**Organizers:** *Richard E. Chinn, Ronald J. Parrington*

Ceramics, polymers, and composites are key materials in many industrial applications, including cutting-edge technologies such as ceramic matrix composites (CMC) for high temperature gas turbine applications. This symposium will examine the materialography, fractography, microscopic examination, and characterization of ceramics, polymers and composites. While traditional approaches to nonmetallic material microscopy and evaluation are welcome, papers that address new and innovative sample preparation and evaluation techniques are of special interest.

### **Invited Speakers**

- Dale Edwards, Engineering Systems Inc.
- Robert Pieper, Element Materials Technology
- Cecilia Larrosa Wilson, Exponent, Failure Analysis Associates

## P11 Metallography and Microstructural Characterization of Metals

**Organizers:** *Coralee McNee, George Vander Voort*

The field of metallurgy and materials science offers many challenges for revealing and characterizing the microstructure of metals and alloys. The art and science of metallography continues to advance to meet these challenges with new automated techniques for preparing and evaluating both new materials and traditional engineering alloys. This symposium will cover all aspects of specimen preparation and evaluation for metals, microelectronics, and virtually any other metallic material, as they influence characterization techniques. Contributions are welcome for all specimen preparation methods. The influence of specimen preparation upon

properly revealing and characterizing microstructure will be the central focus of this symposium covering applications of light microscopy, quantitative metallography and image analysis, micro-indentation hardness, SEM imaging and EMPA, TEM, EBSD or WDS/EDS analysis, and any other relevant method.

### ***Invited Speakers***

- Alexander A. Kazakov, St. Petersburg State Polytechnic University, Russia
- Joseph W. Newkirk, Missouri University of Science and Technology
- Arun M. Gohkale, Georgia Institute of Technology
- Joachim Mayer, RWTH Aachen University, Germany
- Dalaver H. Anjum, King Abdullah University of Science and Technology, Saudi Arabia
- Kodze Karacali, Erdemir, Turkey

## P12 Microscopy and Analysis in Forensic Science

### ***Organizers: S. Frank Platek, Stefanie L. Heckman***

The symposium topics will include the application of light and electron microscopy including x-ray microanalysis, confocal microscopy, atomic force microscopy, FT-IR imaging and Raman mapping and 3D surface metrology in forensic case samples and research. Topics will include case histories and the type of evidence presented for examination, identification of trace evidence and sample preparation for microscopic examination. Also included will be the interpretation of case-related microscopic and spectral results, forensic research topics as well as preparation and presentation of the results of microscopic analyses of trace evidence for court testimony.

### ***Invited Speakers***

- Skip Palenik, Microtrace, LLC
- Nadav Lavin, Israel Police Division, Israel
- Andrew Vogt, AbbVie

[Back to top](#)

## Analytical Sciences Symposia

### A01 Vendor Symposium

#### ***Organizers: Paul Kotula, Teresa Ruiz***

- New methods and techniques
- New developments and technologies
- Breakthrough and new instrumentation
- Improvements to existing instrumentation

### A02 TEM Phase Plate Imaging in Biological and Materials Science

#### ***Organizers: Radostin Danev, Mike Marko***

Conventional imaging with TEM relies on defocus to produce phase contrast. This approach has inherent problems in terms of non-optimal information transfer in Fourier space, especially for low spatial frequencies. Phase plates enable in-focus phase contrast and provide a practical solution for these problems. The theory, construction, and practical use of phase plates will be explored. High-resolution low-dose imaging is facilitated

in biological cryo-EM. In materials science, the combination of a physical phase plate with a Cs-corrector offers an opportunity for characterization of both atomic details and larger structures. The number of laboratories adopting phase plates is rapidly growing and this will be a timely opportunity to share experiences.

### ***Invited Speakers***

- Sara Sandin, Nanyang Technological University, Singapore
- Hong Zhou, University of California, Los Angeles
- Mazdak Radjainia, Monash University, UK
- Miroslava Schaffer, Max-Planck Institute for Biochemistry, Germany
- Matthias Wolf, Okinawa Institute of Science and Technology, Japan
- Felix Baeuerlein, Ludwig Maximilians University Munich, Germany
- Bart Buijsse, FEI Company
- Hirofumi Iijima, JEOL Ltd., Japan

## A03 X-ray Imaging and Analysis

### ***Organizers: Jeff Davis, Ric Wuhrer, Eric Telfeyan***

This broad symposium will accept papers on all aspects of X-ray imaging and X-ray image analysis. Our goal is to bring together the diverse methods of X-ray imaging, such as SEM-EDS mapping,  $\mu$ XRF,  $\mu$ XRD and  $\mu$ CT. We are also emphasizing software for image analysis, including quantitative analysis, multivariate statistical methods and machine learning methods, and we are seeking contributions from the vendor community about new hardware, detectors and techniques. Papers on practical applications of X-ray imaging and correlative microscopy are also encouraged.

### ***Invited Speakers***

- Mirna Saliba, Diamond Light Source, UK
- Ken Moran, Moran Scientific
- Si Chen, Argonne National Laboratory
- Nicholas Yaraghi, University of California, Riverside
- Lothar Strüder, University of Siegen, Germany
- Pierre Hovington, Hydro-Quebec, Canada

## A04 Advances in FIB Instrumentation and Applications in Materials and Biological Sciences

### ***Organizers: Lucille A. Giannuzzi, Nabil Bassim, Srinivas Subramaniam***

Focused ion beam (FIB) instruments are mainstay capabilities for microscopy facilities. FIB columns may be used alone or combined with additional FIB or SEM columns or multiple analytical detectors on a single instrument. The FIB by itself or in combination with other beams and analytical capabilities provides unique methods of specimen preparation, 2D and 3D characterization, and prototyping opportunities. Papers are welcome that covers any of these topics or new applications of FIB-based development and applications.

### ***Invited Speakers***

- Shida Tan, Intel Corporation
- McLean Echlin, University of California, Santa Barbara
- Ehrenfried Zschech, Fraunhofer Institute, Germany
- Konrad Rykaczewski, Arizona State University
- Arash Parsi, Westinghouse

## A05 Applications of Correlative Microscopy to Physical and Biological Sciences

**Organizers:** *Si Chen, Renu Sharma, Nestor J. Zaluzec*

This symposium will focus on the latest developments in correlative microscopy and its applications to physical and biological sciences. Both correlative imaging and spectroscopy are emerging methods that combine two or more complementary imaging or spectroscopy techniques to provide mesoscale or multiple parameter information of a sample or a reaction process. For example, correlative light and electron microscopy combines sub-micron scale information provided by optical and fluorescence signals with (sub-)nanoscale structural information obtained from electron scattering. Synchrotron-based X-ray fluorescence microscopy or spectroscopy in conjunction with electron microscopy provides chemical information in addition to information about the ultrastructure. Sample preparation, modifications to the microscope, or sample holders to suit multiple imaging/spectroscopy techniques and image registration are critical aspects for correlative microscopy, which will also be covered in this symposium.

### **Invited Speakers**

- Ben Giepmans, UMCG, Netherlands
- Matthew Kulzick, BP Corporate Research Center
- Paul Quinn, Diamond Light Source, UK
- Lydia Joubert, Stanford University
- Richard Ortega, University of Bordeaux, France

## A06 Analytical Electron Microscopy for Advanced Characterization from Multi-dimensional Data Acquisition to Integrated Analysis

**Organizers:** *Chaoying Ni, Peter A. van Aken, Masashi Watanabe*

Recent advances in instrumentation related to analytical electron microscopy including high brightness electron sources, stable columns, and efficient signal-detectors allow high resolution analysis with concurrent acquisition of multi-dimensional data: not only traditional analytical signals such as X-rays and energy-loss electrons but also signals for imaging and diffraction. With these multidimensional data, more advanced quantitative information can be obtained such as chemical compositions, electronic structure and local nanostructures. The improved multi-dimensional data acquisitions including diffraction imaging and analytical tomography and advanced quantitative analysis require efficient data processing. This symposium focuses on the latest scientific impact in terms of hardware/software development and new applications of analytical electron microscopy.

### **Invited Speakers**

- Wilfried Sigle, Max-Planck-Institute, Germany
- Mathieu Kociak, Université Paris-Sud, France
- Sara Bals, University of Antwerp, Belgium
- Zineb Saghi, CEA-LETI, France
- Andy Lupini, Oak Ridge National Laboratory
- Ray Egerton, University of Alberta, Canada

## A07 Surface and Subsurface Microscopy and Analysis

**Organizers:** *Vincent S. Smentkowski, John A Chaney, Chanmin Su*

Surface properties (composition, uniformity, thickness, topography, etc.) dictate the performance of many systems. The surface analyst is asked to detect and image species present in ever-lower concentrations and within ever-smaller spatial and depth dimensions. This symposium will emphasize state of the art surface analytical instrumentation including all aspects of surface mass spectrometry and scanning probe microscopy

including nano-scale chemical and physical property analysis via TERS, IR and other probe based techniques. We will also cover advanced data analysis tools; the use of complementary surface analytical instrumentation to perform a complete analysis of complex material systems; and surface analytical challenges. Contributed papers on surface analysis are solicited for both platform and poster presentation.

#### ***Invited Speakers***

- Greg Meyers, Dow Chemical
- Gilber Walker, Toronto University, Canada
- An-ping Li, Oak Ridge National Laboratory
- Mathew Linford, Brigham Young University
- Hammond John PHI, Inc.
- David Surman, Kratos Analytical, UK
- Tim Nunney, Thermo Scientific
- Philipp Bruener IonTof, Germany
- Francois Horreard, Cameca
- Yung-Chen Wang, Castner Group
- Alexander Pirkel, IonTof, Germany

## **A08 Quantitative and Qualitative Microanalysis by EPMA and SEM**

#### ***Organizers: Julien Allaz, Paul Carpenter***

This session will cover advances in quantitative and qualitative microanalysis by EPMA and SEM using WDS and EDS detector systems, trace and light element microanalysis, complementary techniques applied to compositional mapping, the role of standard reference materials, and educational efforts directed toward improvements in microanalysis. We welcome contributed presentations from the scientific and vendor communities, and will highlight the efforts of young scientists and the role of education in microanalysis.

#### ***Invited Speakers***

- Stuart Kearns, University of Bristol, UK
- Anette von der Handt, University of Minnesota
- Edward Vicenzi, Smithsonian Institution
- Dale Newbury, National Institutes of Standards and Technology
- Richard Wuhrer, Western Sydney University, Australia

## **A09 Advanced Scanning Diffraction: Mapping Functionality in Reciprocal Space at Nanometer Resolution**

#### ***Organizers: Jim Ciston, Doug Medlin, Alex Eggemann***

Scanning microscopies drawing on the full field of reciprocal space are rapidly growing in development and application. Recording a full series of diffraction patterns mapped at nanometer resolution liberates the microscope from the limited geometries available for STEM detectors, but more importantly opens new modes for imaging that were previously inaccessible. In addition to structural imaging, it has become possible to map materials properties such as strain, electric/magnetic fields, and octahedral rotations at nanoscale resolution or better. Such developments are being catalyzed by the emergence of new, fast detectors for both electron microscopes and synchrotron sources. Few of these new methods provides a "direct" image, but rely instead upon extensive simulation and data reduction to extract meaningful information. This symposium will focus on the application of these new experimental techniques to nanoscale materials science as well as on the successes, challenges, and needs for the management, processing and visualization of these large data streams.

***Invited Speakers***

- David Muller, Cornell University
- Paul Voyles, University of Wisconsin, Madison
- Colin Ophus, Lawrence Berkeley National Laboratory
- Knut Müller-Caspary, University of Bremen, Germany
- Peter Nellist, University of Oxford, UK
- Kenji Tsuda, Tohoku University, Japan
- Christoph Gammer, Vienna University of Technology, Austria
- Ute Kolb, Johannes Gutenberg-Universität Mainz, Germany

**A10 Advances in Image Processing, Display and Analysis*****Organizers: William A Heeschen, Clifford S Todd, Kevin Eliceiri***

This symposium is focused on recent advances in digital image handling with emphasis on processing, display, and analysis. Potential topics are feature/pattern recognition, segmentation and classification, image transformation, alternate image representation, measurements, visual analytics, and advanced data analysis such as neural networks and machine learning. Advances in image management (storage, retrieval, format, etc.) and remote collaboration are also within the scope of this symposium.

***Invited Speakers***

- Adi Suissa-Peleg, Harvard University
- Andrew Cohen, Drexel University
- Allen Goodman, Broad Institute of MIT & Harvard

**A11 Advances in Scanning Electron/Ion Instrumentation and Detectors*****Organizers: Brad Thiel, Matthew Phillips, Milos Toth***

Recent advances in charged particle optics and instrumentation have the potential to revolutionize where, when and how scanning electron/ion microscopy is used. Miniature and microcolumns may permit SEM capability to be integrated into manufacturing equipment or combined with other analytical instrumentation. Arrays of microcolumns or single columns with beam splitters can provide high-throughput imaging of large areas at high resolution. New electron detector technologies are emerging which offer direct detection of lower energy electrons at high efficiency, and in some cases, energy filtering. Improved photon detectors are also enabling the use of cathodoluminescence in plasmonics research.

***Invited Speakers***

- Pieter Kruit, Delft University of Technology, Netherlands
- Jeff Lichtman, Harvard University
- Larry Muray, Keysight Technologies
- Claudio Piemonte, Fondazione Bruno Kessler, Italy
- Robert Hull, Rensselaer Polytechnic Institute

**A12 Research and Applications in Atom Probe Tomography*****Organizers: Frederick Meisenkothen, Eric B. Steel***

Atom probe tomography (APT) is an emergent characterization technique with tremendous potential. To fully realize this potential, researchers are actively exploring new application areas while simultaneously striving to improve the accuracy and reproducibility of the technique. This symposium is designed to bring together

technicians, engineers, and scientists, from across disciplines, who share a common interest in atom probe tomography. The session will encompass research and applications spanning a wide variety of topics that include: materials applications; optimization of acquisition conditions; correlative techniques, 3-D reconstruction, and data analysis; specimen preparation techniques; detector performance; modeling and measurements to understand the impact of specimen and instrument parameters; and accuracy and precision in APT measurements and the development of APT standards. (NOTE: Meeting attendees who are interested in this session should also consider attending the Atom Probe Pre-Meeting Congress earlier in the week.)

#### ***Invited Speakers***

- Lorenzo Rigutti, Universite de Rouen, France
- David Diercks, Colorado School of Mines
- Mattias Thuvander, Chalmers University of Technology, Sweden
- Emmanuelle Marquis, University of Michigan
- Hans Juergen Kreuzer, Dalhousie University, Canada
- Ty Prosa, Cameca/Ametek

## **A13 *In-situ* Electron Microscopy and Big Data Analytics in 2D and 3D**

### ***Organizers: Huolin Xin, Peter Ercius, Kai He***

The need to measure functionality and dynamics of nanomaterials in liquids and gases calls for imaging tools with high throughput, spatial resolution, and analytical sensitivity. This symposium is dedicated to the development of advanced techniques for *in situ* S/TEM including realistic sample environments with functional stimuli and measurements, developments in high-throughput analytical dynamical imaging, big data analysis, and sample-beam interactions. We encourage submission of work highlighting applications of environmental TEM in electrochemistry, nucleation and growth, catalysis, corrosion, and biological processes. Particular emphasis of this symposium is given to improvements in the time resolution of quantitative imaging by STEM-EELS, STEM-EDX, EF-TEM, ADF-STEM, STEM tomography, etc., for *in situ* and environmental experiments.

#### ***Invited Speakers***

- Reza Yassar, University of Illinois - Chicago
- Raymond Unocic, Oak Ridge National Laboratory
- Megan Holtz, Cornell University
- Haimei Zheng, Lawrence Berkeley National Laboratory
- Seiji Takeda, Osaka University, Japan
- Judith Yang, University of Pittsburgh
- Joerg Jinschek, FEI Company
- Renu Sharma, National Institutes of Standards and Technology
- Andrew Minor, Lawrence Berkeley National Laboratory
- Yimei Zhu, Brookhaven National Laboratory
- Judy Cha, Yale University
- Xiaoqing Pan, University of California, Irvine

## **A14 Single Atom Electron Microscopy and Spectroscopy**

### ***Organizers: Jingyue (Jimmy) Liu, Larry Allard***

Atoms, the basic building blocks of matter, make up the universe and all life forms. Many factors affect how atoms behave, for example, how they are bonded to other atoms. The macro-properties of matter depend on the geometrical arrangement and the bonding of the individual atoms. Aberration-corrected electron microscopes make it possible to analyze the behavior of individual atoms, either supported on a substrate or embedded in a



matrix. Spectroscopy techniques such as XEDS and EELS can be utilized to not only identify the nature of the individual atoms of interest but also investigate their electronic structure or oxidation state. This symposium provides a platform to bring together researchers from a variety of disciplines to highlight the most recent progress in characterizing the nature of individual atoms, studying their interactions with the surrounding environment, and investigating their unique properties. The symposium focuses on all aspects of imaging and analyses of (supported or embedded) single atoms and the correlation of these observations with their functional properties (e.g., electrical, magnetic, catalytic, etc.).

#### ***Invited Speakers***

- Masashi Watanabe, Lehigh University
- Gianluigi Botton, McMaster University, Canada
- Wu Zhou, Oak Ridge National Laboratory
- Ming Yang, General Motors
- Kazu Suenaga, Advanced Industrial Science and Technology, Japan
- David Muller, Cornell University

## A15 Quantitative Measurement of Intensities and Distances in Electron Microscopy

### ***Organizers: James LeBeau, Jinwoo Hwang***

Within the past few years, major breakthroughs have been achieved for quantifying the entire electron microscopy image (intensities, distances, phase, and amplitude). This symposium covers recent advances in accurate/precise measurements in both conventional high resolution and scanning transmission electron microscopies. Invited papers will include technique development and applications where having an absolute, quantitative scale is critical to gaining new material insights. In particular, this symposium will focus on unique and innovative approaches to solve the challenges associated with quantifying images. The target attendees will be a broad mix of materials scientists and physicists aiming to extract more information from their electron microscopy data.

#### ***Invited Speakers***

- Christoph Koch, Ulm University, Germany
- Huolin Xin, Brookhaven National Laboratory
- Peter Nellist, Oxford University, UK
- Naoya Shibata, University of Tokyo, Japan
- Jianwei Miao, University of California, Los Angeles

## A16 New Frontiers in Monochromated EELS

### ***Organizers: Ian MacLaren, Peter Crozier***

Using EELS and EELS spectrum imaging with new monochromated instruments offering < 200 meV energy resolution will revolutionize our understanding of nanoscale processes in materials, nanostructured systems and devices. Specifically, it will have a huge impact on our understanding on the nanoscale localization of low energy excitations in solids, including in plasmonics, vibrational spectroscopy, and interband transitions. Contributions are therefore invited in instrumentation and technique development, applications and data analysis, theory, and correlation to complementary techniques.

#### ***Invited Speakers***

- Ondrej Krivanek, Nion
- Quentin Ramasse, SuperSTEM, UK
- Peter Rez, Arizona State University

- Kazu Suenaga, Advanced Industrial Science and Technology, Japan
- Gianluigi Botton, McMaster University, Canada
- David McComb, The Ohio State University

[Back to top](#)

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## M&M 2016 – Plenary Speakers

Monday, July 25, 2016

Columbus Convention Center

### Professor Mark Miodownik

University College London, UK

#### *Materials for the 21st Century*

Professor Mark Miodownik is the UCL Professor of Materials & Society. He received his Ph.D in turbine jet engine alloys from Oxford University, and has worked as a materials engineer in the USA, Ireland and the UK. For more than ten years he has championed materials research that links the arts and humanities to medicine, engineering and materials science. This culminated in the establishment of the UCL Institute of Making where he is Director and runs the research program ([www.instituteofmaking.org.uk](http://www.instituteofmaking.org.uk)) (<http://www.instituteofmaking.org.uk>). Prof. Miodownik is a well-known author and broadcaster. He regularly presents BBC TV programs on materials science and engineering which have reached millions of viewers in more than 200 countries. In 2013 he was awarded the Royal Academy of Engineering Rooke Medal, and he was elected a fellow of the Royal Academy of Engineering in 2014. He is author of *Stuff Matters* which won the Royal Society Winton Prize in 2014.

### Drew Berry

Walter and Eliza Hall Institute of Medical Research, Melbourne, Australia

#### *Beyond the Limits of Microscopy: Revealing the Unseeable through Hollywood Visual Effects*

Drew Berry is a biomedical animator who creates scientifically accurate and aesthetically rich visualizations that reveal the cellular and molecular processes for a wide range of audiences. Beginning his career as a cell biologist and microscopist, Drew brings a rigorous scientific approach to each project, immersing himself in relevant research to ensure current data are represented. Since 1995, he has been a biomedical animator at the Walter and Eliza Hall Institute of Medical Research. His animations have exhibited at venues such as the Guggenheim Museum, MoMA, the Royal Institute of Great Britain and the University of Geneva. In 2010 he received a MacArthur Fellowship "Genius Grant."

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## 2016 Pre-Meeting Congresses

- Separate registration fee required — see "Registration Fees" for details.
- Breakfast, Lunch, and coffee breaks are included.

### Exploiting the Diffractive Properties of Electrons for Solving Materials Problems

**Sunday, July 24, 2016 • 8:00 AM to 5:00 PM**

*Organized by the Electron Crystallography and Automated Mapping Methods Focused Interest Group*

**Organizers:**

Jörg Wiezorek, University of Pittsburgh

Yoosuf Picard, Carnegie Mellon University

Sergei Rouvimov, University of Notre Dame

Robert Stroud, nanoMegas

This Pre-Meeting Congress reviews basic methodologies in the analysis of crystalline materials using electron diffraction. Both scanning electron microscopy and transmission electron microscopy methods are featured. This Congress will feature nine invited speakers, each an internationally renowned expert in the utilization of electron diffraction methods for analyzing one or more of the following structural properties of crystalline materials: phase/symmetry, orientation, defects, and strain. Each speaker will describe the fundamental physics, explain the basic methodologies and approaches, and highlight key recent research findings and/or important technique developments. This session provides an excellent opportunity for electron microscopists to review SEM and TEM methodologies based on electron diffraction, and gain new insights on the latest advances and applications of state-of-the-art diffraction methods.

### Essentials of Atom Probe Tomography

**Sunday, July 24 — 8:30 AM – 5:00 PM**

*Atom Probe Tomography Focused Interest Group*

**Organizers:**

Richard L. Martens, University of Alabama

Arun Devaraj, Pacific Northwest National Laboratory

Prakash Kolli, University of Maryland

Baishakhi Mazumder, Oak Ridge National Laboratory

Atom probe tomography (APT) has been growing very rapidly over the past decade. Commercial instrumentation and FIB-based specimen preparation have driven much of this growth. Accordingly, the number of people utilizing the technique has also been rising rapidly. This one-day pre-meeting congress, organized by the MSA Atom Probe Tomography Focused Interest Group (APT-FIG), will present the basics of atom probe tomography in an introductory overview. APT instrumentation and experimental design, theory, specimen preparation, data analysis, and applications will be discussed

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## Microscopy Outreach

### X90 Microscopy in the Classroom: Strategies for Education and Outreach

*Craig Queenan, Alyssa Waldron, Dave Becker*

Local educators and registered conference attendees are invited to participate in presentations, round table discussions, and demonstrations of effective strategies for microscopy outreach and education from K-12 and beyond. This session will show how microscopy in education serves as an important learning tool for inspiring our future STEM professionals. Those involved in microscopy education or educational outreach are encouraged to submit a paper about their successful program or lesson for platform or poster presentation.

- Best Practices for incorporating microscopy into K-12 classrooms and curricula
- Corporate and academic institutions and programs involved in microscopy outreach, both locally and nationally
- Methods to expose students to microscopy in an engaging and successful manner

### X91 Family Affair

*Elaine Humphrey, Stuart McKernan*

The exciting world of microscopy opens for attendees' family and friends. This session includes:

- A mystery to solve using microscopy
- Materials science and biological science

### X92 A Project MICRO Workshop

*Elaine Humphrey, Caroline Schooley*

- The Project MICRO workshop will change its venue this year to the MegaBooth all week after the Exhibit Hall opens
- Visit the Outreach booth every day to see how to set up different stations in a classroom
- How to have fun with microscopy outreach and kids (adults love this too)
- Get to see different microscope systems for use in a classroom, in action

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## M&M 2016 Sunday Short Courses

**Organizer: Elizabeth Wright, Emory University**

- These full-day courses run from 8:30 AM to 5:00 PM on Sunday.
- A certificate of participation will be issued to each participant.
- Two (2) Continuing Microscopy Education Units are available (registration fee \$10 for members).
- Morning and afternoon coffee breaks are included. (Breakfast & lunch are on your own.)
- **Separate registration/fees required** (click [here \(/MandM/2016/registration/fees.cfm\)](/MandM/2016/registration/fees.cfm) for more information).

### X10 Cryo-preparation for Biological EM

***Kent McDonald, Danielle Jorgens, Rick Webb, Helmut Gnaegi***

In this course, we will review why cryo-techniques for biological specimen preparation are superior to conventional methods. We will discuss some low-cost cryo-methods, as well as some of the latest equipment and techniques for high-pressure freezing, freeze substitution, cryosectioning and correlative LM-EM. We will show how to recognize ice-damage artifacts and provide a library of reference materials that can be accessed online after the course. Persons taking this course should leave with a better understanding of these biological cryotechniques and their role in different applications such as correlating light and EM, EM tomography, EM immunolabeling, cryo-EM of vitrified sections, as well as their routine use for the best-available preservation of cellular fine structure.

### X11 Electron Cryotomography Image Processing Using RELION

***Sjors Scheres, Tanmay Bharat***

The course will begin with an explanation of the RELION algorithm. Next, the limitations of tomographic data will be discussed along with the missing wedge. Strategy for CTF estimation and CTF correction using the combined 3D CTF and missing wedge model in RELION will be explained. The practical course that will follow will show how to setup of files and directories for RELION sub-tomogram averaging, including generation of 3D CTF models. Tomographic data will then be classified in 2D and 3D. Finally, sub-tomogram averaging will be conducted using the auto-refinement program in RELION with an emphasis on how to assess refinement quality, Euler angle distributions and whether more data is needed.

### X12 Imaging and Analysis with Variable Pressure or Environmental SEM

**CANCELLED*****Brendan J. Griffin***

This short course aims to take the challenge out of imaging in variable-pressure SEM mode. We will sequentially address VPSEM column components and operation: electron (SE and BSE), and light (CL) imaging and x-ray analysis strategies and detectors for both biological and materials samples. Procedures for monitoring instrument performance and optimizing image quality will then be presented. Examples of the novel charge-related contrasts available in VPSEM will also be discussed. The appropriate use of hot, cool and cold stages is included. The course will conclude with invited manufacturer presentations on new developments and a final lecture comparing VPSEM with conventional SEM. Lecture pdfs will be available online.

**X13 Practical Considerations for Image Analysis and Use of ImageJ/Fiji*****James Grande***

The course first focuses on a wide range of practical topics in the field of image analysis, covered in an easy-to-understand format so that users with little or no experience can comprehend how image analysis can provide extensive quantitative measurements leading to better understanding of material performance. Treating image analysis as a problem-solving tool, along with discerning key metrics within a microstructure, will be discussed through several real-life examples. The course then will cover the use of the public-domain image-analysis package ImageJ/Fiji. This analysis tool will be explored in terms of its extensive capabilities and types of image-analysis projects, using several examples. Programming considerations will be discussed, with basic examples of batch-processing images for enhanced analysis of structural features. Finally, the strengths and weaknesses of image-analysis tools, and options for applying them in various types of imaging systems, will be described and discussed.

**X14 Advanced Focused Ion Beam Methods*****Lucille Giannuzzi, Joe Michael***

The use of FIB instruments in materials and biological science laboratories is growing rapidly. The versatility and capabilities of these tools are also rapidly improving. This course will first cover ion/solid interactions, which are so important for a user of FIB instrumentation to understand. We will then discuss techniques of sample preparation for SEM and TEM, using conventional liquid-metal Ga<sup>+</sup> ion FIBs. We will introduce liquid-metal alloy sources, the gas field-ionization source, the plasma-ion source, and the various ions that are now commercially available to benefit differing applications. The course will conclude with discussions of 3D applications and nanofabrication.

**X15 Nanomaterial Microscopy & Microanalysis: Tools and Preparation*****Lou Germinario, Phillip Russell, John Thornton***

With the wide variety of analytical instrumentation available, the selection of the correct "tool" for analysis of nanomaterials is critical. By introducing various microscopy and microanalysis methods, this workshop should provide a solid foundation for nanomaterial characterization for the beginning to intermediate investigator. The importance of choosing the proper preparation technique, to minimize introduction of artifacts and to ensure that representative samples are identified for subsequent analysis, will also be discussed.

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## Tutorials

### Physical Sciences Tutorials

#### X43 Diffraction Mapping and 4D STEM

*Speaker: Christopher Gammer*

- Recent developments in fast electron detectors enable recording maps of diffraction patterns during STEM acquisition
- The recorded dataset allows reconstruction of virtual diffraction patterns from arbitrarily small regions or virtual dark-field images with specifically designed apertures
- Strain mapping using nanobeam electron diffraction combines nanometer resolution with a high precision and a very large field of view

#### X44: Compressive Sensing Applications in Microscopy

*Speaker: Andrew Stevens*

- Compressive sensing (CS) background
- How CS is different from traditional low dose and high-speed techniques
- Some approaches for CS microscopy (e.g., scanning probe, parallel beam, spectroscopy)
- Implementation difficulties

### Biological Sciences Tutorials

#### X40 Career Tracks in Government and Industry: A Panel Discussion

*Speakers: Benjamin Bammes, DirectElectron; Gabriella Kiss, FEI; Paula Flicker, NIH*

#### X41 Effective Tactics for Getting an Equipment Grant

*Speaker: Ken Taylor, Florida State University*

#### X42: Building and Validating Atomic Models for EM Density Maps

*Speaker: Matthew Baker, Baylor College of Medicine*

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## M&M 2016 – Technologists' Forum

### X30 Technologists' Forum – Analysis of Real Data and Recognition of Artifacts

***Cathy Johnson, Caroline Miller, Frank Macaluso***

Critical to every researcher and technologist is the ability to identify and interpret data correctly. Incorrect and incomplete specimen preparation often results in compromised data, without any perception by the end user. This symposium will allow you to improve your skills at recognizing both preparation and imaging artifacts that too often occur in today's published research. Guidance on improving analysis data will also be offered. This Tech Forum Platform session will review artifact identification in various Cryo SEM and TEM techniques, in addition to room temperature imaging and analysis.

### Technologists' Forum Special Topic: Image Analysis and a Practical Approach to Current Software Solutions and Their Applications

***Frank Macaluso, Cathy Johnson, Caroline Miller***

Image analysis is an integral component of every imaging experiment for extracting quantitative information for meaningful presentation of image data. Freeware and commercial software packages are available for a myriad of applications including: finding shapes, counting objects, measuring object properties, particle tracking, deconvolution, single particle reconstruction, morphometric analysis, 3D visualization and 4D quantitative analysis. This session will feature a practical approach to current software solutions and their applications.

### X32 Technologists' Forum, Roundtable Discussion on Artifacts

***E. Ann Ellis, Lee Cohen-Gould, Vicky Bryg***

This forum will be a continuation and further discussion of the artifacts and the interpretation of micrographs as it applies to material, biological or cryo samples. Panelists will include Core Facility directors and speakers from the special topic session who will be able to respond to questions from participants about how to recognize artifacts, determine their cause(s) and correct procedures. Participants will thus be able to take this information home with them to successfully deal with these problems in their own labs and will be better able to explain the importance of following proper SOPs to their clients.

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## Post-Deadline Posters

The post-deadline poster submission deadline has passed. No additional submissions are being accepted at this time. We look forward to seeing your work at M&M 2017 in St Louis.

Click on each paper title to link to the original 2-page paper. All Post-Deadline Papers below will be presented as Posters on Monday, July 25, 2016 from 3-5 PM, in the poster area of the M&M 2016 Exhibit Hall.

Post-deadline papers are not included in the program or proceedings.

PDP Board Number	Author Name	Paper Title
1	Shiliang Zhang	Glutamatergic Neurons from the Ventral Tegmental Area Establish Multiple Synapses on Single Parvalbumin-GABAergic Interneurons in the Nucleus Accumbens (abstracts/PDP-1.pdf)
3	Yong Wu	Measuring Globule Size Distribution of Cyclosporine Ophthalmic Emulsion by Cryogenic Electron Microscopy (abstracts/PDP-3.pdf)
4	Yong Wu	Cryogenic Transmission Electron Microscopy Reveals Accurate Size and Shape of Iron Cores of Intravenous Iron Drug Formulations (abstracts/PDP-4.pdf)
5	Yan Xin	Observing Pt Atoms on CeO <sub>2</sub> Nano-rods (abstracts/PDP-5.pdf)
6	Shize Yang	Quantitative Scanning Transmission Electron Microscopy Study of Monolayer RexMo <sub>1-x</sub> S <sub>2</sub> (abstracts/PDP-6.pdf)
7	Raul Versaci	Characterization of Carbon Nanotubes Manufacture by Plasma CVD Technique (abstracts/PDP-7.pdf)
8	Jiro Usukura	A New Approach for the Direct Visualization of the Membrane Cytoskeleton in Cryo-Electron Microscopy: A Comparative Study with Freeze-Etching Electron Microscopy (abstracts/PDP-8.pdf)
9	John Neville	Delayed Plant Senescence Through Novel ACC-deaminase Activity in Induced <i>Rhodococcus rhodochrous</i> DAP 96253 (abstracts/PDP-9.pdf)
10	Larry Oakford	Surface Enhanced Fluorescence of Quantum Dots on Self-assembled Plasmonic Platforms (abstracts/PDP-10.pdf)



11	Xiaoxu Zhao	<b>STEM Characterization of Epitaxial Monolayer MoS<sub>2</sub></b> (abstracts/PDP-11.pdf)
12	Milan Heczko	<b>Study of deformation microstructure and corresponding surface relief in high alloyed austenitic steel Sanicro 25 after low cycle fatigue</b> (abstracts/PDP-12.pdf)
13	Gary Li	<b>Characterization of Glass Particles in Biopharmaceutical Drug Products by Microscopic and Spectroscopic Methods</b> (abstracts/PDP-13.pdf)
14	Mandy Nevins	<b>Image Restoration using Point Spread Function Deconvolution</b> (abstracts/PDP-14.pdf)
15	Sibel Ebru Yalcin	<b>Label-Free Visualization of Protein Structure and Conformation using Infrared Nanospectroscopy</b> (abstracts/PDP-15.pdf)
16	Albert Hilton	<b>Scanning Joule Expansion Microscopy for Device Failure Analysis</b> (abstracts/PDP-16.pdf)
17	Takeshi Kaneko	<b>Development of New Generation Cryo TEM</b> (abstracts/PDP-17.pdf)
18	Scott Montross	<b>Microanalysis of Rare Earth Elements in Coal Utilization Byproducts</b> (abstracts/PDP-18.pdf)
19	Circe Verba	<b>Organic and Nonorganic Characterization of the Bakken, Marcellus, Pierre, and Woodford</b> (abstracts/PDP-19.pdf)
20	Haibo Yu	<b>Solidification Microstructures in Ag<sub>3</sub>Sn-Cu<sub>3</sub>Sn Pseudo-Binary Alloys</b> (abstracts/PDP-20.pdf)
22	Ken Hayes	<b>CdTe Solar Cell Optimization by Planar and Transmission EBSD</b> (abstracts/PDP-22.pdf)
23	Jie Yang	<b>In-situ Transmission Electron Microscopy for Characterizing Electrochemical Deposition of Nanostructured Materials</b> (abstracts/PDP-23.pdf)
24	Gerald Baker	<b>Structure of the Tibial Brush Setae of the Bedbug, Cimex lectularius L. (Hemiptera: Cimicidae)</b> (abstracts/PDP-24.pdf)
25	Najat A. Alharbi	<b>SEM Characterization of Alkali Activated Slag</b> (abstracts/PDP-25.pdf)
26	Keria Bermudez-Hernandez	<b>The Interaction Factor: Quantifying Protein-Protein Interactions by Stochastic Modeling of Super-Resolution Fluorescence Microscopy Images</b> (abstracts/PDP-26.pdf)
27	Robert Carlton	<b>Corrosion of Molded Glass Vials for Parenteral Pharmaceuticals</b> (abstracts/PDP-27.pdf)
28	Jing Lu	<b>Quantitative Study of Sb Segregation in InAs/InAs<sub>1-x</sub>Sb<sub>x</sub> Type-II Superlattices for IR Photodetectors</b> (abstracts/PDP-28.pdf)
29	Claire Chisholm	<b>Deformation Mechanisms of Geological Materials at the Nanoscale</b> (abstracts/PDP-29.pdf)
30	Midori Hitomi	<b>A case of advanced chronic kidney disease with giant mitochondria in renal tubular cells</b> (abstracts/PDP-30.pdf)
31	Lucille Giannuzzi	<b>Site Specific EBSD, S/TEM, and XEDS, of a PFIB EXLO Meteorite Sample</b> (abstracts/PDP-31.pdf)

32	Satoko Okayama	<b>Three Dimensional Localization of Mitochondrial Nucleoid within a Mammalian Cell by Using CLEM Method Combined with FIB-SEM (abstracts/PDP-32.pdf)</b>
33	Elaine Schumacher	<b>Beyond FIB EXLO: Use of a Micromanipulator System for Transfer of Small Particles and Thin Films (abstracts/PDP-33.pdf)</b>
34	Edward White	<b>STEM Cathodoluminescence Mapping of Surface Traps in ZnO Nanowires (abstracts/PDP-34.pdf)</b>
35	Angela Goode	<b>Dynamic spectro-microscopy of nanoparticle growth and corrosion (abstracts/PDP-35.pdf)</b>
36	Maayan Cohen	<b>The Brass Nails of the Akko Tower Wreck (Israel): Archaeometallurgical Analyses (abstracts/PDP-36.pdf)</b>
37	Hugh Porter	<b>Progress Towards Reliable EELS Quantification of GaSb-GaAs Heterostructures (abstracts/PDP-37.pdf)</b>
38	Satya Ganti	<b>Analysis of Porosity in Additively Manufactured Parts using 3D Metallographic Analysis Compared to Conventional 2D Stereology Estimates (abstracts/PDP-38.pdf)</b>
39	Sergey Babin	<b>Characterization of Imaging Systems at Nanoscale using Modulation Transfer Function (abstracts/PDP-39.pdf)</b>
40	Shiladitya Chatterjee	<b>Polyallylamine as an Adhesion Promoter for SU-8 Photoresist (abstracts/PDP-40.pdf)</b>
41	Kenneth Fahy	<b>3D Cell Structure Imaging with Laboratory Scale Cryo Soft X-ray Tomography (abstracts/PDP-41.pdf)</b>
42	Hessam Ghassemi	<b>Paraelectric Behavior of 0.75(Na<sub>0.5</sub>Bi<sub>0.5</sub>)TiO<sub>3</sub>-0.25SrTiO<sub>3</sub> Under Induced Electric- Field (abstracts/PDP-42.pdf)</b>
43	Alastair Doye	<b>Determining local structural and chemical ordering in amorphous MoSi<sub>x</sub> for superconducting nanowire single-photon detectors (abstracts/PDP-43.pdf)</b>
44	Janicek Blanka	<b>Aberration-Corrected STEM Characterization of Phase Behavior in (Mo/W)Te<sub>2</sub> Alloys (abstracts/PDP-44.pdf)</b>
45	Takeo Sasaki	<b>Approaches to achieving ultra-high-vacuum in 60 kV ultra-high-resolution STEM microscope (abstracts/PDP-45.pdf)</b>
46	Martin Sohn	<b>Characterization of a Deep UV Reflection Microscope for Quantitative Measurement using Angular Tool Functions (abstracts/PDP-46.pdf)</b>
47	Vincent Carlino	<b>BSE Detector Revived Through Plasma Ashing (abstracts/PDP-47.pdf)</b>
48	Jamil Clarke	<b>Optimized Method of Sample Preparation and an Automated Examination and Sizing of PZT Ceramic Powders using SEM (abstracts/PDP-48.pdf)</b>
49	Melainia McClain	<b>Bringing Speed and Automation Together with the ASP-1000 (abstracts/PDP-49.pdf)</b>
50	Tyler C. Gruber	<b>Celebrating 75 Years of Industrial Electron Microscopy (abstracts/PDP-50.pdf)</b>
51	Marcus Hanwell	<b>Interactive and Reproducible 3D Visualization for Large Electron Tomography Datasets (abstracts/PDP-51.pdf)</b>

52	Zachery Oestreicher	Examining the Polymerization of Recombinant MamK onto the Membrane of Magnetosomes Using the High-Speed Atomic Force Microscope (abstracts/PDP-52.pdf)
53	Luxi Li	X-ray Fluorescence Microscopy analyses of Three-Way Catalyst aging and deactivation in Gasoline Particulate Filter Application (abstracts/PDP-53.pdf)
54	Christopher Andolina	In situ Early Stage Oxidation Observations of Copper (100), (110), and (111) Facets Using Environmental High-Resolution Transmission Electron Microscopy (abstracts/PDP-54.pdf)
56	Deb Pratiti	Breaking Friedel's Law in Polar Two Dimensional Materials (abstracts/PDP-56.pdf)
57	Leonardo Jácome	3D Reconstruction, Visualization and Quantification of Dislocations from Transmission Electron Microscopy Stereo-Pairs (abstracts/PDP-57.pdf)
58	Michael Cao	Single Atom Diffractometry Enabled by Electron Microscope Pixel Array Detectors (abstracts/PDP-58.pdf)
59	Seung-Yong Lee	Investigation of Fast Li-Diffusion at the Early Stage of Discharge in Tunnel Structured $\alpha$ -MnO <sub>2</sub> Nanowires by In-situ Transmission Electron Microscopy (abstracts/PDP-59.pdf)
60	Hsin-Hung Lee	Optimal Design of Microscopic Fluid Chip System Used for Scanning Electron Microscopes (abstracts/PDP-60.pdf)
61	Kevin Lee	Micro Environment Simulation of Microscopic Fluid Chip System Applied to Scanning Electron Microscopes (abstracts/PDP-61.pdf)

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(/MandM/2016/)

## Apply for a Meeting Award

Meeting award applications are made during paper submission. The online submission site is now closed and will open for M&M 2017 papers on December 1, 2016.

No additional scholarships or travel awards are available for M&M 2016. Several **onsite awards** will be given during the meeting which do not require advance application.

## Onsite Awards

The M&M meeting's co-sponsoring societies confer competitively judged awards **at the meeting**.

### MSA Student Poster Awards

We believe poster presentations are an excellent format for all participants to engage in intensive discussion with other researchers in the field. To especially encourage students to take advantage of this opportunity and submit papers for poster presentation, MSA provides cash awards to the most outstanding student posters (first author) each day (up to one in each of three categories).

### Diatome Poster Awards

All posters illustrating the use of diamond-knife ultramicrotomy are eligible. Prizes include cash and Swiss watches.

### MAS Best Paper Awards

MAS annually confers awards for papers presented at the M&M meeting deemed to be best in four categories. Each comes with a cash award generously provided by MAS Sustaining Members.

## Micrograph Competitions

### IMS Metallographic Contest

This annual contest solicits micrographs that illustrate problem-solving using a variety of imaging techniques, with cash prizes awarded in each of several classes. Go to <http://www.asminternational.org/web/ims/> (<http://www.asminternational.org/web/ims/>) for submission details.

### MSA Micrograph Competition

This competition rewards the innovative blending of art and science. Winning micrographs will be selected on the basis of artistic merit and general audience appeal. The winner of the 2015 Micrograph Competition is

featured in the 2016 Call for Papers brochure. A maximum of three (3) awards will be presented; First Prize: \$200; Two Second Prizes: \$50 each.

### Criteria

- Entries must be scientifically significant
- Entries must contain novel information useful in resolving a scientific issue, and/or
- Present established information in a way that dramatically enhances its comprehension or interpretation.

### Rules

1. An individual may submit a maximum of two (2) entries (one award per entrant).
2. Entries must have overall dimensions of 11" x 14" (horizontal or vertical), and be affixed to a stiff lightweight support (e.g. "foam board"). Micrographs may be mounted so that they have borders.
3. Each entry must have a separate text sheet with the title and a 200-word (max) description of the image, including the technique and its scientific significance. Text is recommended to be printed in 14-pt Times New Roman font on a separate 8½" x 11" sheet. Entrant's name, address, employer/institution, email address, and image title shall be posted on the back of the mounted entry(ies).
4. ***Entries must be brought to the meeting in Columbus and mounted on the display boards by 12:00 noon on Monday, July 25, 2016.***
5. Non-winning entries must be removed Thursday afternoon by 3:00 PM. Micrographs remaining after that time will be discarded.
6. Winners will be announced at the meeting during the Wednesday afternoon poster awards. Submitted micrographs remain the property of the entrants subject to the conditions above.

*The winning image of the 2015 MSA Micrograph Competition is featured on Page 8 of the M&M 2016 Call for Papers brochure.*

## M&M Meeting Awards

The Microscopy Society of America (MSA) and the Microanalysis Society (MAS) annually sponsor awards for outstanding papers contributed to the Microscopy & Microanalysis (M&M) meeting, which are competitively judged based upon the quality of the submitted paper. These awards are provided to students, postdoctoral researchers, and professional technical staff members to help defray travel, lodging and other costs of attending the meeting. All awardees must fit the award criteria, as described below, at the time of the M&M meeting.

### General Considerations

Award applicants will automatically be considered for memorial scholarships, conferred by MSA based on the generous support of society sponsors.

Applicants who have previously received an M&M Meeting Award will not be considered for a second award in the same category.

### Students

All full-time students enrolled at accredited academic institutions are eligible for student awards. High school, undergraduate, and graduate students are encouraged to apply. Applicants are not required to be members of the sponsoring society.

### Postdoctoral Researchers

All full-time postdoctoral researchers are eligible for post-doc awards. Applicants are not required to be members of the sponsoring society.

### Professional Technical Staff Members

Full-time technologists are eligible for staff awards. In addition, **the applicant must be a member of the sponsoring society**, current in his or her dues for the year of the meeting.

### Amount of Award

M&M Meeting Awards and memorial awards consist of full meeting registration and up to \$1,000 for travel-related expenses. Original receipts must be provided to receive travel reimbursement. All award winners also receive an invitation to the Presidents' Reception, held on the Tuesday evening of the meeting.

### Notification of Award

All award applicants will be notified by email of their award status approximately eight weeks after the Call for Papers deadline. Unsuccessful applicants will be permitted to withdraw their papers, should their ability to attend the meeting be contingent on the award, within one week following notification.

### Requirements of Award

All award winners must present their paper in person at the M&M meeting in order to receive their award. Awardees are expected to attend and participate in the entire meeting, which runs from Sunday evening's opening reception through late Thursday afternoon.

Awardees are required to attend the Monday morning plenary session, at which their award will be conferred.

### How to Apply For an M&M Meeting Award

1. As part of the on-line paper submission process, an applicant must flag his or her paper for award consideration. Only one paper may be designated and considered per applicant.
2. **The applicant must appear as first author and presenter of the paper submitted for award.**
3. The applicant must provide the name, title, institution, and e-mail address of his or her supervisor, who will be contacted to provide a supporting letter and confirmation of applicability for the indicated award category (e.g. student, post-doc, or technical staff).

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