CALL FOR PAPERS

Submission Deadline: February 16, 2023

M&M 2023
MICROSCOPY & MICROANALYSIS
Minneapolis, MN • July 23-27

www.microscopy.org/MandM/2023
for up-to-date meeting information

Look inside for a list of Symposia,
Plenary Speakers and more!
The Microscopy Society of America (MSA) and the MicroAnalysis Society (MAS), warmly invite you to attend the Microscopy & Microanalysis (M&M) 2023 meeting in Minneapolis, Minnesota from July 23 to 27, 2023. Minneapolis, nicknamed “the City of Lakes”, is known for its extensive public park systems and abundance of water. The last time M&M was held in Minneapolis was in 1996. Just like 17 years ago, we will be congregating in the Minneapolis Convention Center (MCC).

M&M 2023 will kick off with two fantastic plenary lectures by Dr. Stefanie Milam from the NASA James Webb Space Telescope (JWST) project and Dr. Karin Sauer from the Biofilm Research Center at Binghamton University. The plenary presentations will be followed by our main scientific program. The success of each M&M meeting owes to hundreds of symposium organizers who volunteer their time to identify trendy research directions and engage experts worldwide to present their work at our meetings.

For M&M 2023, more than 140 symposium organizers have assembled 10 symposia in the physical sciences, 15 in analytical sciences, 10 on biological sciences, as well as five cross-cutting symposia. We highly encourage you to support these symposia by submitting abstracts of your own research and contributing to the platform and poster presentations. Among the 40 scientific symposia that will be offered in the scientific program, two of them are dedicated to two legendary electron microscopy researchers who sadly passed away in 2022: Drs. Klaus Keil (1934-2022) and David Joy (1944-2022). Both these outstanding scientists, mentors, educators, and leaders made landmark contributions to our field. We will also pay tribute to another great teacher and leader from our community by celebrating Dr. Wilbur Bigelow’s centennial birthday in 2023.

Another unique addition in 2023 is a new symposium titled “A Lens on Diversity in the Microscopy and Microanalysis Community” to be jointly organized by Drs. Rhonda Stroud, Shery Chang, Molly McCartney and Treva Brown, the chair of the newly formed Diversity, Equity, and Inclusion Committee (DEI). This symposium will serve as a forum for the discussion of the state of the microscopy community, celebration of the contributions from historically under-represented, under-recognized groups, and for sharing inclusive recruitment and retention strategies. Opting for a more open discussion forum, the first symposium in 2023 will only accept poster presentations. The “Lens on Diversity” posters will be on display for the entire duration of the meeting. The organizers invite you to submit abstracts to describe your own experiences, the contributions of women or minority microscopists and STEM education programs in your university/college, etc. This discussion will help us moving toward building a better and more inclusive M&M community. Look out for announcements of special social hours with drinks and snacks served in the Lens on Diversity poster area during the meeting.

On behalf of MSA, MAS, the M&M 2023 Executive Program Committee, the meeting management team, all the symposium organizers and countless volunteers, we look forward to greeting you in Minneapolis for an exciting and stimulating Microscopy & Microanalysis 2023.

Ru-ching Hsia, Carnegie Institution for Science
M&M 2023 Program Chair
A01 Microscopic Approach of Materials for Agri-Food Process
ORGANIZERS:
H. Javier Anselmo Villegas M., Universidad Michoacana de San Nicolás de Hidalgo, Mexico
Leslie Ieri Rangel Vázquez, DK-NANOTEC
Dhananjay Tripathi, Institute of Nuclear Medicine and Allied Sciences, DRDO, India
- AIB
- Agri-materials
- Nano-Agriculture
- Food-conservation
- Food-Transportation
- Eco-sustainability

A02 Microscopy and Microanalysis for Real World Problem Solving
ORGANIZERS:
Ke-Bin Lee, BASF Corporation
Jeremy Beebe, The Dow Chemical Company
Xiaofeng Zhang, Nanosys
Abigail Lindstrom, National Institute of Standards and Technology
- Real world problem solving using all forms of microscopy and microanalysis.
- Practical applications of correlative methods employing microscopy and related techniques.
- Quantitative approaches for increased confidence in results from non-ideal samples.
- Creative methodologies for preparation and analysis of real-world samples.
- Equipment testing, calibration, and quality assurance.

A03 Standards and Reference Materials and their Applications in Quantitative Microanalysis
ORGANIZERS:
Emma Bullock, Carnegie Institution for Science
Will Nachlas, University of Wisconsin
Andrew Mott, Texas A&M University
Supported by the FIGMAS FIG
- The use of standards and reference materials in quantitative microanalysis and the needs of the analytical community for improving such materials.
- Synthesis, evaluation, distribution, and maintenance of standards and reference materials.
- Development of new protocols for microanalytical techniques.
- Applications of standard-based techniques to solving microanalytical problems.

A04 The Praxis of 4D-STEM - Extracting Information from Biological and Functional Materials
ORGANIZERS:
Yima Han, Rice University
Colin Ophus, Lawrence Berkeley National Laboratory
David A. Muller, Cornell University
Weipei Gao, North Carolina State University
- New applications of 4D-STEM to structural biology and soft matter structure-property measurements.
- Experiments which map fields, phase, structural distortions, orientation, and other sample properties on many length scales.
- Computational methods including machine learning to analyze data-intensive 4D experiments, including in situ 4D-STEM.
- Overcoming challenges for phase contrast reconstructions, from instrument calibration to thick samples.
- Dose-efficient imaging techniques such as phase contrast methods or multimodal data synthesis.
- New detectors and instrumentations, as well as community standards for availability of data, standardization of analysis, and best practices.

A05 Advanced Measurement Techniques in (S)TEM-EELS
ORGANIZERS:
Matthew Bugnet, CNRS, University of Lyon, France & SuperSTEM Laboratory, UK
Stefan Löffler, TU-Wien, Austria
Armin Feist MPI-NAT & University of Göttingen, Germany
- Novel measurement methods for low-loss and core-loss EELS.
- High spatial resolution probe of electronic excitations (orbitals, plasmons, phonons...), including ultrafast EELS, gain and optical phase resolved spectroscopy.
- Unconventional probing techniques (beam shaping, tuning channeling, smart scanning).
- Improvement of EELS data quality: better SNR, lower damage, event-based detection.
- Application of novel EELS acquisition schemes to (non-)biological materials.

A06 Learning from Failure: Negative and Null Results in Microscopy
ORGANIZERS:
Josh Sugar, Sandia National Laboratories
Suzy Vitale, Carnegie Institution for Science
David Cullen, Oak Ridge National Laboratory
- Identification of artifacts from sample preparation.
- Observation of unexpected materials or beam interactions.
- Mitigation of unconscious operator bias.
- Errors in data acquisition and interpretation.
- Failed experimental design and accidental discoveries.

A07 In Memoriam of David Joy: Scanning Electron and Ion Microscopy
ORGANIZERS:
Raynauld Gauvin, McGill University, Canada
Dale Newbury, National Institute of Standards and Technology
- Fundamentals and practice of scanning electron and ion microscopy, scanning transmission electron microscopy and variable pressure scanning electron microscopy.
- Theory and practice of secondary electron imaging with electrons and ions.
- Monte Carlo simulations of electron and ion trajectories.
- Electron channeling imaging in the scanning electron microscope.
- Metrology in the scanning electron and ion microscope.

A08 Advances in Focused Ion Beam Instrumentation, Applications and Techniques in Materials and Life Sciences
ORGANIZERS:
Matthew Thorseth, The Dow Chemical Company
Lena Wolff, California Institute of Technology
K.D. Derr, Thermo Fisher Scientific
Supported by the Focused Ion Beam FIG
- Latest developments in novel ion sources, FIB instrumentation, and enhancing analytical detectors (EDS, WDs, EBSD, EBIC, SIMS, TKD, CL, Raman, etc.).
- Innovations in FIB microscopy including automation, nanofabrication, lithography, imaging with charge neutralization, etc.
- Novel geometries, milling strategies, non-standard lift outs for TEM/STEM, and innovative micro and nano-structure prototyping.
- Advances in cryo-FIB and working with beam-sensitive materials.
A09 Analytical Scanning Probe Microscopy
ORGANIZERS:
Greg Haugstad, University of Minnesota
Liang Gong, 3M
- Non e-beam-based submicron analytical microscopy.
- Contrast mechanisms employing radiative, mechanical, electro/magnetic, thermal methods including but not limited to tip-based chemical imaging.
- AFM, STM, EFM/KFM/MFM, SNOM, TERS, PTIR (optical and tip based) microscopy and related methods.

A10 The Road to Atomic Scale Tomography
ORGANIZERS:
Brian Gorman, Colorado School of Mines
Thomas Kelly, Steam Instruments, Inc.
Simon Ringer, University of Sydney, Australia
- Development of Atomic Scale Tomography Atomic Resolution Imaging and Analytical Measurements in 3-D.
- Correlative and integrating data from multiple characterization methodologies.

A11 Nanoscale Infrared Spectroscopy with Electrons and Photons
ORGANIZERS:
Jordan Hochtel, Oak Ridge National Laboratory
Rainer Hillenbrand, CIC-nanoGUNE, Spain
Andrea Kanevca, Brno University of Technology, Czech Republic
Xingxu Yan, University of California-Irvine
- Electron beam spectroscopies (EELS, PINEM, CL).
- Scanning near-field optical microscopies (s-SNOM, nano-FTIR, AFM-IR, PIFM, TERS).
- Theoretical calculations of infrared vibrational, optical, and electronic properties (DFT, BEM, analytical).
- Localized excitations at heterogeneities in nanostructures (point defects, interfaces, surfaces).
- Multi-dimensional analysis (spatial, spectral, momentum, time).

A12 New Methods for Accessing the Structure, Chemistry and Effect on Dynamic Processes of Solid-Liquid Interfaces
ORGANIZERS:
Patricia Abellan, CNRS-MN, Nantes University, France
Joe Patterson, University of California-Irvine
Jennifer Cookman, University of Limerick, Ireland
Katherine L. Jungjohann, National Renewable Energy Laboratory (NREL)
- The development and application of cryogenic and liquid phase methods for accessing liquid-solid interfaces.
- Visualization and description of catalytic processes in liquids at high resolution.
- The study of the electrode/electrolyte interface at the nanometer scale.
- New correlative approaches and cryogenic methods for site-specific sample preparation.
- The impact of surfaces and interfaces on the production of radicals, reaction kinetics and other related processes.
- Electron-beam damage studies at solid-liquid interfaces.

A13 Computational Advances in Electron Microscopy
ORGANIZERS:
Debangshu Mukherjee, Oak Ridge National Laboratory
Joshua Agar, Lehigh University
Leopoldo Molina-Luna, TU Darmstadt, Germany
- Open-source electron microscopy software for processing microscopy images, hyperspectral datasets from EELS and EDX, strain mapping from 4D-STEM datasets, ptychographic reconstruction from 4D-STEM datasets.
- Advancements in simulation of transmission electron microscopy data, with special focus on simulations that focus on inelastic electron scattering and interface directly with first-principles simulations.
- Improvements in the accuracy and speed of strain quantification, quantification of structural distortions, inverse problems such as focal series reconstructions or ptychography using deep neural networks.
- Processing of microscopy datasets in the electron dose-limited regime through computational techniques – with applications focusing on both biological materials such as proteins and single particles, along with electron dose sensitive materials such as zeolites and hybrid organic perovskites.

A14 Surface and Subsurface Microscopy and Microanalysis of Physical and Biological Specimens
ORGANIZERS:
Jeff Fenton, U.S. Department of Energy
Xiao-Ying Yu, Oak Ridge National Laboratory
Ryan Wagner, Purdue University
Vincent Smentkowski, GE Research
- Recent developments in surface analysis and instrumentation.
- Advances in scanning probe microscopy for quantitative analysis including nano-scale chemical, mechanical, thermal, & electrical analyses, for example, AFM-IR, multifrequency AFM, sMIM, etc.
- Applications of ellipsometry, surface topographical analysis, and high energy or synchrotron based XPS.
- Enhancing traditional electron microscopy methods through the use of surface analysis.
- Multitechnique data correlation through the use of advanced data processing: Multivariate analysis, machine learning, and hyperspectral data.

A15 Klaus Keil Memorial Session: Quantitative Microanalysis of Planetary Materials
ORGANIZERS:
Poul Carpenter, Washington University in St. Louis
Rhonda Stroud, Arizona State University
Owen Neil, University of Michigan
- Quantitative microanalysis of planetary materials with emphasis on lunar and meteorite samples and their mineralogy.
- Advances in EDS and WDS X-ray spectrometry, spectrum processing and data mining.
- High resolution microscopy and applications to planetary materials.
- Advances in detection and quantification of volatiles in geological and planetary materials with μCT, Raman spectroscopy, EELS, APT or SiM}.
Challenges and innovation in Imaging techniques and instrumentation
Application of advanced or innovative Electron microscopy in a diagnostic Molecular modeling.
Progress in automation and robustness New software and algorithm Advancement in super-resolution Advances in design and fabrication Modeling image formation in a soft X-ray microscope instrumentation Improvements in high-resolution Obtaining ANN for large data Super-resolution microscopy. Correlation of soft X-ray tomography data Predicting structure—function relationship, Novel approaches and applications for Specimen handling and cryo-preservation. Software for data processing Application of microscopy techniques and Live cell imaging using optical Automated feature recognition Computational techniques for 3D Structure and function of macromolecular Cryo-electron tomography Application of microscopy techniques, New fluorophores and sample Progress on macro imaging systems including live imaging, LM, EM, cryo LM, cryo EM, to study plants, insects, aquatic animals, or symbiotic systems. Imaging techniques and instrumentation to study the effect of the environment (e.g., microbe, organic and inorganic matter, nutrients, and temperature) on living organisms. Application of microscopy techniques and instrumentation to study microbiomes and symbiotic relationships.

3D Structures: from Macromolecular Assemblies to Whole Cells (3DEM FIG)
ORGANIZERS:
Teresa Ruiz, University of Vermont
Melanie Ohi, University of Michigan
Cheri Hampton, AFRL/RXAS Wright-Patterson Air Force Base
Edward Eng, New York Structural Biology Center
Supported by the 3DEM FIG
• Structure and function of macromolecular complexes in vitro and in vivo.
• Single particle cryo-electron microscopy.
• Cryo-electron tomography.
• Molecular modeling.

Machine Learning in Biological Imaging – How to Train Your Artificial Neural Network
ORGANIZERS:
Alice Dahnalikova, Pacific Northwest National Laboratory
Neerja Zambare, Pacific Northwest National Laboratory
• Various imaging strategies for obtaining structural data used for ‘training’ artificial neural networks (ANN).
• Demonstration of AI/ML methods and algorithms, including deep learning.
• Challenges in finding patterns descriptors for an automated data collection.
• Obtaining ANN for large data volumes acquisition, analysis testing and validation.
• Automated feature recognition segmentation approaches.
• Predicting structure—function relationship, based on ANN learned information.

Development, Challenges and Biomedical Applications of Tissue Clearing, Super-resolution Microscopy and Tissue Imaging
ORGANIZERS:
Yangxin Zhao, Carnegie Mellon University
Alan M. Watson, University of Pittsburgh
Adam Glaser, Allen Institute for Neural Dynamics
• Development and applications of tissue clearing technologies in biological specimens.
• Advancement in super-resolution microscopy technologies and their biomedical applications in tissues.
• Progress on tissue staining, advanced tissue preparation methods and hardware advancements inspired by novel tissue preparation protocols.
• Progress on macro imaging systems for both live and fixed tissue specimens (i.e. Two-photons, light sheet, high-speed confocal and tomography approaches).
• Development of computational approaches for storing, processing, visualizing large volumetric image data.

Technical Advances in cryoEM
ORGANIZERS:
Alexis Rohou, Genentech
Christopher Russo, MRC Laboratory of Molecular Biology, UK
Anchi Cheng, New York Structural Biology Center
Timothy Grant, Morgridge Institute
• Advances in design and fabrication of cryoEM instruments and consumables.
• New software and algorithm developments for cryoEM, cryoET and microED.
• Improvements in high-resolution tomography and subtomogram averaging.
• Progress in automation and robustness of workflows.
• Integration of multiple modalities and length scales.

Innovations in Light Microscopy: Revealing the Inner Workings of Life from Single Molecule to Whole Organisms
ORGANIZERS:
Jay Potts, University of South Carolina
Rengaswamy (Sai) Veeraraghavan, The Ohio State University
• Super-resolution microscopy.
• Correlative microscopy.
• New fluorophores and sample labeling strategies.
• Live cell imaging using optical microscopy.
• Computational techniques for 3D reconstruction, extracting spatial or temporal dynamics from imaging data.

Electron and Light Microscopy Research and Diagnosis of Diseases in Humans, Animals and Plants
ORGANIZERS:
Marcelo Redigolo, West Virginia University
Shared Research Facilities
Claudia López, Oregon Health & Science University (OHSU)
Supported by Diagnostic & Biomedical Microscopy FIG
• Application of advanced or innovative EM techniques to study host-pathogen interactions, virulence factors and ultrastructural changes.
• Novel approaches and applications for correlative or hybrid microscopy.
• Electron microscopy in a diagnostic network: recruitment of instruments and microscopists around the world during critical situations and outbreak management, such as a pandemic.
• Developments on sample preparation workflow for EM analysis of complex tissue for diagnosis or research.

BIOLOGICAL SCIENCES SYMPOSIA

July 23-27, 2023 | Minneapolis, MN
**INTERDISCIPLINARY (CROSS-CUTTING) SYMPOSIA**

**B09 Volume Electron Microscopy in Biological Research – Instrumentation, Sample Preparation and Data Handling**

**ORGANIZERS:**
- Alice Liang, New York University Langone Health
- Camenzind G. Robinson, St. Jude Children’s Research Hospital
- Paul Verkade, University of Bristol, UK

- Demonstrating the power and potential of vEM, and introducing the 4 technical approaches to achieving a 3D EM data set, the instrumentation and techniques required, as well as their advantages and limitations.
- Discussing sample preparation challenges which differ between 2D and 3D EM approaches, and the workflow of correlative 3D light to 3D EM.
- Correlating images and metadata from LM, EM and other modalities (i.e., XRM, chemical imaging).
- Describe processing, storage, and distribution of large image data in cell biology, and discussing issues in computing when dealing with large vEM datasets.
- Adapting and applying open-source tools and frameworks for image processing and analysis
- Implementation of scalable solutions for small and mid-sized labs and facilities.

**B10 Microscopy and Microanalysis of Interfaces and/or Interactions Among Organic and Inorganic Matter**

**ORGANIZER:**
- Dongqiao Zhao, University of Missouri-Kansas City
- Haiilang Dong, Miami University
- Nan Yao, Princeton University

- Tooth’s enamel-dentin junction and bone-muscle interface.
- Bacterial infections and colonizations associated with implanted biomaterial and medical devices.
- Embedded foreign fragments in human or animal body.
- Hybrid organic-inorganic materials for optical, electronic, energy and medical applications.
- Biocorrosion and Bionomineralization
- Organic-mineral interfaces in terrestrial and extraterrestrial materials.

**C01 Machine Intelligence in Action: Delivering Resilient, Sustainable, and Reconfigurable Microscope Ecosystems**

**ORGANIZERS:**
- Steven R. Spurgeon, Pacific Northwest National Laboratory
- Lewys Jones, Trinity College, Dublin
- Regina Ciancio, Istituto Officina dei Materiali-CNR, Italy
- Ryo Ishikawa, University of Tokyo, Japan

- Machine intelligence for automated and autonomous discovery workflows.
- Instrument sustainability, energy footprint, lifecycle, and end-of-life repurposing.
- Discovery of hidden correlations and inverse problems.
- Interoperable hardware, standardization of modules, open-drivers, and scripting.
- Augmenting human intuition through new hardware-software interfaces.

**C02 Extracting Information from Data: Applications of Artificial Intelligence in Microscopy Application of Artificial Intelligence to Microscopy in the Materials and Biological Sciences**

**ORGANIZERS:**
- Peter Ercius, Lawrence Berkeley National Laboratory
- Kevin Roccapriore, Oak Ridge National Laboratory
- Eric Stach, University of Pennsylvania

- Discovery of hidden correlations and inverse problems.
- Open software and open frameworks for microscopy and spectroscopy.
- Workflows aligned with FAIR data stewardship principles.

**C03 Correlative and Multimodal Microscopy and Analysis**

**ORGANIZERS:**
- Si Chen, Argonne National Laboratory, USA
- Xiao-Ying Yu, Oak Ridge National Laboratory, USA
- Rahul Areval, University of Zaragoza, Spain
- Nestor Zaluzec, Argonne National Laboratory, USA

- Correlative microscopy/spectroscopy instrumentation, methodology, and applications.
- Cryogenic and in-situ sample preparation and handling.
- Data analysis pipeline, data fusion, ML/AI of data analytics.

**C04 Lens on Diversity in the Microscopy and Microanalysis Community**

**ORGANIZERS:**
- Rhonda Stroud, Arizona State University
- Shery Chang, University of New South Wales, Australia
- Molly McCourt, Arizona State University
- Treva Brown, Naval Research Laboratory

- Demographic studies of membership compared to STEM workforce in relevant specialties (biology, materials science, geosciences etc.).
- Who is underrepresented at what stage?
- Examples of successful programs and technologies that enable wider participation in microscopy and microanalysis.
- Contributions that identify and address current obstacles to academic and professional advancement for women and minority microscopists.
- Female and minority perspectives across all career stages concerning current advances in electron microscopy
- Biographical sketches and scientific contributions of hidden figures in M&M history.

**C05 Vendor Symposium**
Battery materials, solar cells, fuel cells and their materials subjected to multiple extreme environments. Strategies for microstructure-centric fission and fusion energy materials, advanced reconstruction algorithms and tomographic techniques that push the current and advanced nuclear fuels. Data science and data mining of in-situ heating, materials applications: analytical microscopy via SEM, TEM, localized probes for the atomically precise manipulation of materials, and high-throughput workflows for characterization and quantification of AM microstructures.

**P02** Atomically Precise Manipulation of Materials

**ORGANIZERS:**
Toma Susi, University of Vienna, Austria  
Andrew Lupini, Oak Ridge National Laboratory  
Demie Kepaptsoglou, University of York, UK  
Quentin Ramaße, SuperSTEM Laboratory, UK

- Localized probes for the atomically precise manipulation of materials.  
- Understanding atomistic dynamics via modeling and theory.  
- Machine learning and artificial intelligence for automation.  
- Characterization of the controlled modification of specimen properties.

**P03** Theory and Applications of Advanced Electron Tomography

**ORGANIZERS:**
Robert Hovden, University of Michigan  
Andrew Lupini, Oak Ridge National Laboratory  
Mary Scott, University of California-Berkeley  
Peter Ercius, Lawrence Berkeley National Laboratory

- Structure-property relationships in 3D across the atomic to nanoscale.  
- Advanced reconstruction algorithms and theory (discrete, atomic, compressed sensing, psychographic, etc.).  
- Tomographic techniques that push the limits of spatial resolution, time, or in-situ environments.  
- Multi-modal (multi-detector, spectroscopic) 3D reconstruction and visualization.

**P04** Correlative Microscopy of Rapidly Solidified Microstructures in Additively Manufactured Builds

**ORGANIZERS:**
Donovan Leonard, Microsoft  
Sarshad Rommel, University of Connecticut  
Sriram Vijayan, Ohio State University  
Cain Hung, Collins Aerospace

- Microstructures of additively manufactured components in as-deposited and post-processed conditions.  
- Multi-length scale characterization of microstructure in additively manufactured components.  
- Strategies for microstructure-centric qualification of additively manufactured builds.  
- High-throughput workflows for characterization and quantification of AM microstructures.

**P05** Microscopy and Microanalysis of Materials under Multiple Environmental Extremes

**ORGANIZERS:**
Timothy Lach, Oak Ridge National Laboratory  
Yuanynan Zhu, University of Connecticut  
Daniel Schreiber, Pacific Northwest National Laboratory

- Fission and fusion energy materials, accelerator materials, and space materials: metals and alloys, ceramics, composites, polymers, semiconductors, nuclear fuels and waste materials, etc.  
- Materials subjected to multiple extreme conditions: high radiation dose, varying dose rates, high stress, high strain rates, oxidation and corrosion, transmutation, high or very low temperatures, etc.  
- Damage phenomena: dislocation loops, segregation and precipitation, phase transformations, bubbles and void nucleation, oxidation, dealloying, etc.  
- Analytical microscopy via SEM, TEM, aberration-correction, scanning probe, in-situ microscopy, etc.  
- Microanalysis via microprobe, atom probe, mass spectrometry, etc.  
- Modeling and machine learning approaches that aid in interpretation of microscopy data of these phenomena.

**P06** Imaging and Micro/Nano Analysis of Materials for Nuclear Applications

**ORGANIZERS:**
Jing Wang, TerraPower  
Assel Aitkalyeva, University of Florida  
Mukesh Bachhav, Idaho National Laboratory

- In-situ and high-throughput experimentation.
- Current and advanced nuclear fuels and materials.
- Microstructure characterization of materials for advanced reactors.
- Microscopy and microanalysis advances in nuclear research.
- Data science and data mining of microscopy-based datasets.

**P07** Prof. Wilbur C Bigelow Centenary Symposium In Situ Heating and Gas-Reaction Studies in Materials Sciences

**ORGANIZERS:**
Lawrence Allard, Oak Ridge National Laboratory  
Kinga A Unocic, Oak Ridge National Laboratory  
Abhaya K Datye, University of New Mexico  
John F. Mansfield, University of Michigan (retired)

- In situ heating, materials applications: catalysts, nanoparticles, alloys, structural materials, etc.
- Applications and phenomena: sintering, diffusion, phase transformations, nucleation and growth, battery materials, electrical properties, etc.
- Gas Reactions (both Closed Cell and E-TEM methods): catalysts, high-temperature corrosion, extreme environments, water vapor applications, effects of pressure, effects of gas composition, gas composition measurements (RGA), operando studies, etc.
- Challenges, limitations, sample preparation, improvements, new directions, etc.

Published
*Tulip bud,* by Andrei Savitsky, independent microscopist, Cherasky, Ukraine
PHYSICAL SCIENCES SYMPOSIA cont.

P08 Atomic Scale Microscopy of Interfaces and Heterostructures with Correlated Phenomena
ORGANIZERS:
Jinwoo Hwang, Ohio State University
Menglin Zhu, Ohio State University
Salva Salmani Rezaie, Ohio State University

- Microscopy of atomic structure at the interface that relates to, for example, interfacial interaction, proximity effect, charge transfer, and magnetic ordering.
- Interfaces and heterostructures that consist of, for example, strongly correlated materials, ferroelectrics and multiferroics, (antiferromagnetic insulators, low dimensional materials, and Van der Waals interface.
- Characterization of atomic scale structure that bridges condensed matter theory and property measurements of novel interfaces and heterostructures.

Published
Tulip bud, by Andrei Savitsky, independent microscopist, Cherasky, Ukraine

P09 Advances in Cryogenic Transmission Electron Microscopy and Spectroscopy for Quantum and Energy Materials
ORGANIZERS:
Michele Conway, Imperial College London, UK
Ismail El Baggari, Harvard University
Miaofang Chi, Oak Ridge National Laboratory

- Advancements in cryogenic S/TEM holders, such as temperature control and extreme low liquid helium temperatures.
- Advancements in cryogenic in-situ holders (e.g. additional applied stimulus such as bias, magnetic field or strain and controlled vacuum conditions).
- Combination with advanced S/TEM techniques (phase related, spectroscopy, 4D-STEM) and electron spectroscopy techniques.
- Synergies with theoretical methods and data science, including advanced microscopy data acquisition and analysis methods.
- Phase transitions and dynamic process at cryogenic temperatures, and interplay of quantum phenomena such as charge, spin, orbital, lattice correlations.
- Applications of cryogenic S/TEM and EELS for energy materials such as battery materials, fuel cells, and catalysts etc.

Published
Agate from Brazil, by Bernardo Cesare, University of Padova, Padova, Italy

P10 Advanced Imaging and Spectroscopy for Nanoscale and Sensitive Materials
ORGANIZERS:
Kai He, University of California-Irvine
Meng Gu, Southern University of Science and Technology, China

- Advances in new imaging modes and hardware developments.
- Atomic-scale spectroscopy and low-dose imaging.
- Cryo-TEM and cryo-STEM-EELS.
- Applications to nanoscale structures and interfaces of energy, quantum, and functional materials.

M&M2023

TECHNOLOGISTS’ FORUM SEMINARS

X30 Technologists’ Forum Symposium: Methods in Tissue Clearing and Expansion to Achieve Improved Resolution
[Partnering with B04]
ORGANIZER:
D. Page Baluch, Arizona State University

This session will cover:
- Advancement in super-resolution microscopy technologies and their biomedical applications in tissues.
- Progress on tissue staining and advanced tissue preparation methods.
- Review the development of macro imaging systems for both live and fixed tissue specimens.

X31 Technologists’ Forum Symposium: New and Developing Technologies in Light Microscopy
[Partnering with B06]
ORGANIZER:
D. Page Baluch, Arizona State University

This session will cover:
- Super-resolution microscopy.
- Correlative microscopy.
- New fluorophores and sample labeling strategies.
- Live cell imaging using optical microscopy.

X32 Technologists’ Forum Symposium – 4D STEM Tips and Techniques
[Partnering with A04]
ORGANIZER:
John L. Grazul, Cornell University

This session will cover:
- New applications of 4D-STEM to structural biology and soft matter structure-property measurements.
- Experiments which map fields, phase, structural distortions, orientation, and other sample properties on many length scales.
- Dose-efficient imaging techniques such as phase contrast methods or multimodal data synthesis.
How to Apply For an M&M Meeting Award:

• Apply for M&M meeting awards during the online paper submission process. Applicants must check the box during submission to have their paper considered for an award. Only one paper may be designated per applicant.

• The applicant must appear as first author and presenter of the paper submitted for award.

• The applicant must provide the name, title, institution, and e-mail address of their 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).

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 students in good standing enrolled at accredited academic institutions are eligible. High school, undergraduate, and graduate students are encouraged to apply. Applicants are not required to be members of the sponsoring society. If an applicant is not a full-time student, their submitted work “MUST” have been done at their academic institution in their role as student. Student applicants are required to provide their advisor’s name and email address during the application process.

POSTDOCTORAL RESEARCHERS:
All postdoctoral researchers are eligible. Applicants are not required to be members of the sponsoring society. If an applicant is not a full-time researcher, their submitted work “MUST” have been done at their institution in their role as post-doc researcher. Postdoctoral researchers are required to provide their advisor’s name and email address during the application process.

PROFESSIONAL TECHNICAL STAFF MEMBERS:
Full-time technologists/technicians are eligible. In addition, the applicant must be a member of the sponsoring society, current in their 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 of their award status approximately eight weeks following the Call for Submissions 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. Awards or award monies are non-transferable.

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 in up to one in each of three categories – physical, analytical, and biological.

Ultramicrotomy Awards
Posters that wish to be considered for the Ultramicrotomy awards should indicate this in their online paper submission. Ultramicrotomy awards consist of a trip to Switzerland from first place and a Swiss watch for second place. These awards are sponsored by Diatome US.

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.

Microscopy Today Micrograph Awards
Scientifically significant micrographs:

- Published category (images published in 2022)
- Open category (unpublished images)
- Video category (movies and 3-D reconstructions)

Deadline for submission is February 16, 2023
Prizes awarded at M&M 2023 in Minneapolis, MN
Karin Sauer, PhD
Professor and Chair, Department of Biological Sciences, Binghamton University
Co-Director, Binghamton Biofilm Research Center (BBRC)
Co-Director, Microbial Biofilms REU
Editor-in-Chief, FEMS Microbiology Reviews

Biofilms – Life upon First Contact and Beyond

Karin Sauer, an internationally known expert on biofilm development and antibiotic resistance, has dedicated her career to research that can improve outcomes for patients fighting chronic infections. Dr. Sauer is professor and chair of the Department of Biological Sciences at Binghamton University, where she also serves as co-director of the Binghamton Biofilm Research Center, and co-director of the Microbial Biofilms REU program. Her research has garnered support from the National Science Foundation, the National Institutes of Health, private industry and other sources. She is the author of over 80 peer-reviewed publications on subjects ranging from biofilm dispersal techniques to the role of biofilms in cystic fibrosis. Sauer, who holds a doctorate in microbiology and biochemistry from the Max-Planck-Institute for Terrestrial Microbiology, was a postdoctoral research associate at Montana State University. Her most recent project focuses on infections related to implanted medical devices.

Stefanie Milam, PhD
Deputy Project Scientist for Planetary Science, James Webb Space Telescope (JWST)
Astrochemistry Laboratory
NASA Goddard Space Flight Center

Dr. Milam works in the Astrochemistry Laboratory at the NASA Goddard Space Flight Center. She is an expert in rotational spectroscopy, observations, and laboratory modeling of astrochemistry and molecular astrophysics of the interstellar medium, evolved stars, star formation regions, and comets. Her observational focus is on the compositional studies of primitive bodies, namely comets and interstellar objects, and uses ground- and space-based facilities to understand their connection to the formation and evolution of planetary systems. She also has a laboratory dedicated to simulate interstellar/cometary/planetary ices and detect trace species employing the same techniques used for remote observations to help constrain the chemical complexity of the ices, the amount of processing that occurs, and interpret past and present data from missions that observe ice features. Dr. Milam has been working on the James Webb Space Telescope (JWST) as Deputy Project Scientist for Planetary Science since 2014. Under this role she has helped enable observations within our own solar system from Near-Earth Asteroids to the farthest reaches of the Kuiper belt and even the brightest objects in the infrared sky (e.g. Mars). She has also led the study team for solar system science for WFIRST. In 2021, she was honored with asteroid 40706 (1999 RO240) was renamed to 40706 Milam. She received the NASA Exceptional Scientific Achievement Medal in 2022 for her work on enabling Solar System Science with JWST.
SUNDAY SHORT COURSES

All short courses held Sunday, July 23, 2023, 8:30 am - 5:00 pm. Separate registration fee—see registration form for details.

**X10 High Resolution Structure Determination by cryo-EM**

LEAD INSTRUCTOR:
Tim Grant
Morgridge Institute - University of Wisconsin-Madison

- Theory of EM optics and image formation
- Theory of cryo-EM computational image processing steps
- How to use cisSTEM to process cryo-EM data

**X11 Guidelines for Performing 4D-STEM Characterization from the Atomic to >Micrometer Scales: Experimental Considerations, Data Analysis and Simulation**

LEAD INSTRUCTORS:
David Muller, Cornell University
Colin Ophus, Lawrence Berkeley National Laboratory

- Electron detector technology suitable for 4D-STEM experiments.
- List of possible 4D-STEM experimental configurations and references.
- Analysis software for characterizing large numbers of STEM diffraction pattern images and visualization of the results.
- Software and tutorial for simulating 4D-STEM datasets.

**X12 Biological EM Sample Processing Short Course—Part Two**

LEAD INSTRUCTORS:
Ru-ching Hsia, Carnegie Institution for Science
Alice Liang, NYU Langone’s Microscopy Laboratory
Kirk Czymmek, Donald Danford Plant Science Center

- Alternative fixation methods: Cryo and microwave methods.
- Advanced ultramicrotomy techniques: cryo-ultramicrotomy and serial sectioning.
- Immuno EM.
- Volume EM using scanning electron microscope: Serial Block Face SEM, Focused Ion Beam-SEM and Array tomography.
- Correlative microscopy.
- Practices of image analysis and postprocessing, segmentation and visualization.

**X13 Cryo-EM for Materials Sciences: Hardware, Applications and Data Acquisition**

LEAD INSTRUCTORS:
Ismail El Baghawi, Harvard University
Myung-Geun Han, Brookhaven National Laboratory
Michael Zachman, Oak Ridge National Laboratory

While cryogenic TEM has revolutionized the research in biological science, its applications in materials sciences have been relatively limited. The major challenges lie in realizing reliable cryogenic specimen preparation, and atomic-scale imaging and spectroscopy at a wide range of cryogenic temperatures. Though still in its infancy, recent advancements in cryo-EM, especially in cryo-FIB and new TEM stages, have brought us the promises.

This short course will focus on the fundamentals of cryo-EM and primarily benefit those new to the field. We will highlight historical developments, current state, and future perspectives of cryo-EM for materials science. We will cover critical steps involved in a successful cryogenic microscopy study, including specimen preparation, specimen transfer, cryogenic FIB, new cryo-TEM stages, imaging, spectroscopy at low temperatures, and data analysis methods that can potentially be used to assist cryo-EM data acquisition and data analysis.

**X14 Transmission Electron Microscopy and Spectroscopy from First Principles**

LEAD INSTRUCTORS:
Toma Susi, University of Vienna, Austria
Jacob Madsen, University of Vienna, Austria
Paul Zeiger, University of Stockholm, Sweden
Rebecca Nichols, University of Oxford, UK

- (Scanning) transmission electron microscopy image simulations
- Introduction to open-source TEM image software package.
- Computational exercises for modeling common imaging modes.
- First-principles simulation of electron energy-loss spectroscopy.
- Introduction to principles of low-loss and core-loss modeling.

**X15 Automation for the Microscopy Workflow - Serial Sectioning of Materials at the Meso-scale**

LEAD INSTRUCTORS:
Mike Chapman
Rich Martens

- Automation of sample preparation.
- Automation of analytical instrumentation, data acquisition and characterization.
- Methods for large data – handling, storage, sharing, networking.
- Improving data analysis efficiency, pathways to automation.
- Optimizing current and emerging technologies to close the loop.

**X16 Large Area Hyperspectral Mapping, EBSD/EDS/TKD/STEM, Machine Learning Data Analysis, Oh My!**

LEAD INSTRUCTORS:
Chad Parish, Oak Ridge National Laboratory
Donovan Leonard, Microsoft

- Sample Preparation: Ar ion milling, electropolishing, carbon replica, FIB site specific.
- Acquisition Parameters: Correlative, multi-length scale 30kV STEM/EDS/TKD; 200kV STEM/EDS; Large Area Mapping.
- Data Analysis Approaches: PCA, Variational Bayesian Gaussian Mixture Models (VB-GMM).

Published
Diptera larva by Karl Gaff, Karl Gaff Microscopy, Dublin, Ireland
PREMEETING CONGRESSES

**X60 Annual Pre-Meeting Congress for Students, Post-Docs, and Early-Career Professionals in Microscopy and Microanalysis**

*Organized by the Microscopy Society of America Student Council (StC)*

**Saturday, July 22, 2023 • 8:30 AM - 5:00 PM**
Separate registration required – see registration form (Spring 2023)

**INCLUDED IN REGISTRATION FEE:**
Friday evening social event; breakfast, AM Break, Lunch, PM Break, Saturday evening banquet

**PROGRAM CHAIRS:**
Andres Marquez-Rossy, UT Knoxville and Louisa Mezache, The Ohio State University

**PHYSICAL SCIENCES CO-CHAIR:** Yifan Wang, Arizona State University

**POST-DOC LIASON:** Neerja Zambare, Pacific Northwest National Laboratory

This pre-meeting congress is organized by and for students, postdocs, and early-career professionals, and provides:

- A forum for early-career professionals to deliver presentations to peers ahead of the meeting.
- Opportunities to share research and data in an engaging, non-intimidating, and interactive setting.
- Expanded professional networking, and career development mentoring from recent graduates.
- The opportunity to win awards, determined by peer voting.

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**X61 Advances in Focused Ion Beam Technologies**

*Organized by the MS AFIB Focused Interest Group*

**Saturday, July 22, 2023 • 8:30 AM - 5:00 PM**
Separate registration required – see registration form (Spring 2023)

**PROGRAM CHAIRS:**
Annalena Wolff, California Institute of Technology
Bruce Arey, Pacific Northwest National Laboratories

Advances in focused ion beam technologies have created new opportunities in microscopy, microanalysis, materials/bio-engineering and nano-fabrication. This workshop aims to introduce the emerging technologies and applications in the field of focused ion beams, including SIMS, liquid metal alloy ion sources, plasma- as well as gas field ion sources and cold beams. The PMC will motivate how these emerging technologies and approaches extend the traditional Ga LMIS FIB technology and application space. The different technologies and applications will be explained by experts in the field including John Notte, Chad Rue, Dr. Nico Klingner, Dr. William Rickard.

- Advances in FIB technology.
- Ga- VS GFIS- VS plasma- VS LMAIS sources.
- SIMS.
- Technology and application space for different systems.

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**X62 Facilities Management: Skills, Strategies, and Best Practices**

*Organized by the MSA Facilities Operation and Management Focused Interest Group*

**Sunday, July 23, 2023 • 8:30 AM - 5:00 PM**
Separate registration required – see registration form (Spring 2023)

**INCLUDED IN REGISTRATION FEE:**
Breakfast, AM Break, Lunch, PM Break

**ORGANIZERS:**
Josefina Arellano, University of Texas at Dallas
Luisa Amelia Dempere, University of Florida
Elizabeth Miller, Michigan Technological University

This PMC will focus on procedures and plans for the operation of Centers and Cores.

Topics covered within this PMC include:

- Fiscal reporting.
- Federal compliance with grants invoicing.
- Assessment of cost of operation and review of rates.
- User training and certification.

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**X63 Imaging in the Pharmaceutical, Biopharmaceutical, and Medical Health Products Industry**

*Organized by the M&M Pharma Focused Interest Group*

**Sunday, July 23, 2023 • 8:30 AM - 5:00 PM**
Separate registration required – see registration form (Spring 2023)

**INCLUDED IN REGISTRATION FEE:**
Breakfast, AM Break, Lunch, PM Break

**ORGANIZERS:**
Jonathan Boyd, AstraZeneca
Somya Singh, Merk

This PMC will focus Artificial Intelligence (AI) and its role in imaging. Topics covered within this PMC include:

- How to choose which AI approach works best based on the samples.
- A discussion of how to set standards for AI based image analysis.
- Understanding the “black box” of AI based image analysis methods.
Hardware and Software Developments in Electron Microscopy

Jointly Organized by the Electron Microscopy Data Analysis and Management & Aberration-Corrected Focused Interest Groups

Sunday, July 23, 2023 • 8:30 AM - 5:00 PM
Separate registration required – see registration form (Spring 2023)

INCLUDED IN REGISTRATION FEE:
Breakfast, AM Break, Lunch, PM Break

ORGANIZERS:
Debangshu Mukherjee, Oak Ridge National Laboratory
Andrew Lupini, Oak Ridge National Laboratory
Wyeth Gibson, University of California, Irvine
Alexander Rakowski, Lawrence Berkeley National Laboratory
Steven Spurgeon, Pacific Northwest National Laboratory

This PMC will focus on the latest technological developments in both the data generation (hardware) and data analysis (software) aspects of high-resolution electron microscopy. Topics covered will include:

- **Hardware:**
  - New high-brightness, high coherence electron sources and next-generation monochromation capabilities.
  - New developments in lenses such as electrostatic phase plates.
  - Magnetic field free high-resolution electron microscopy.
  - New developments in electron detectors.

- **Software:**
  - Developments in rapid simulation of electron microscopy.
  - Developments in automated microscopy operation, data acquisition and real-time data processing.
  - Software-driven Optimal Design of experiments.
  - Developments in AI and ML applications to electron microscopy experiment design.

Published
Water boatman by Karl Gaff, Karl Gaff Microscopy, Dublin, Ireland

Unpublished
Magnet Microstructure by Felix Trauter, Aalen University, Aalen, Germany

Unpublished
Diatom, Mark Webber, Galiano Island, Canada
Thank You to Our Sustaining Members

(As of December 1, 2022)

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