



(/MandM/2023/)



View the M&M 2023 meeting platform and full schedule today!

Please note: All M&M 2023 sessions and activities are located at the Minneapolis Convention Center in downtown Minneapolis, Minnesota, unless otherwise indicated.

Meeting Platform (<https://mm2023.eventscribe.net/index.asp>)

We're excited to announce that the M&M 2023 event website and conference app are now ready for you to access! Use the email you registered with and your Registrant ID to login! Registration/logging in is not required to view the full schedule on the website. The mobile app does require registration.

Use the website and app to:

- Review the schedule and create your personal itinerary.
- Connect with fellow attendees & speakers.
- Plan which exhibitors you would like to meet.

A few easy steps to help you enjoy M&M 2023:

- Log in with the link and credentials provided below. Update your profile information and add a photo.
- Keep this email handy on event days so it's easy to access.
- All sessions will take place in the **CENTRAL TIME ZONE**.

Download the Official Mobile App

Go to the Apple App Store or Google Play to download the free M&M 2023 mobile app.

You can also download the app and find M&M 2023 event by scanning the below QR code.



Health & Safety

Meet Minneapolis, the city's Convention and Visitor's Bureau (CVB), are operating in accordance with the guidelines set by the state of Minnesota.

MSA and MAS will continue to provide information about the meeting location and COVID-19 requirements to attendees and exhibitors if any changes occur.

To keep up to date and learn more about what Minnesota is doing to keep visitors safe at a state level, please visit the following resources:

COVID-19 Information (<https://www.minneapolis.org/covid-19-health-safety/>)



(<https://www.rms.org.uk/>)

Go to Post-Deadline
Poster Abstracts (/MandM/2023/program/postdeadline_posters.cfm)



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For Authors & Presenters

M&M 2023 Call for Papers is NOW OPEN!

Go to Submission Site (<https://www.abstractscorecard.com/cfp/submit/login.asp?EventKey=YRXSWXNG>)

- **Manuscript Preparation & Information**
(https://www.microscopy.org/MandM/2023/program/Manuscript_Preparation_Guidelines2023.pdf) (.pdf)
- **Paper Template**
(<https://www.microscopy.org/MandM/2023/program/MMPaperTemplate2023.doc>) (.doc/.docx)

Please whitelist or mark this email (mmspeakers@microscopy.org (<mailto:mmspeakers@microscopy.org>)) as a safe sender so you can receive all official communications from Meeting Management! Don't let it get caught in spam!

The presenting author will be notified of presentation type (platform or poster) and day/time assignments in April 2023.

For Platform Presenters

1. **Computers are NOT provided for your presentation.** You must bring or arrange for your own computer for your presentation. Both Mac and PC formats are supported.
2. **The default ratio for projectors at M&M 2023 is 16:9 (high definition).** Please plan your slides accordingly. A 4:3 ratio will work; however, there will be black vertical bars on either side of your projected image.
3. Both HDMI and VGA cables will be provided. We recommend HDMI for HD projectors.

4. If you don't have a computer to bring, ask your symposium organizer or session chair if you can use another presenter's machine.
5. If you bring a computer, please make sure that you have administrative access and know the password.
6. If possible, we suggest bringing your presentation on a flash drive and/or storing it online so that you have access to it in case your computer has technical problems.
7. If you wish to preview your presentation, a Speaker Ready Room will be available.

For Poster Presenters

- Papers will be assigned by the Program Committee to either a Platform or Poster presentation, unless "Prefer Poster" is selected in the online paper submission site. Authors will be notified of their assignment. Poster assignments will specify a presentation day AND a setup day, which may not be the same day. *(For example: Poster Setup: Saturday; Poster Presentation: Sunday.)*

PLEASE NOTE:

- No A-V equipment will be provided for ANY poster presentations.
- Poster presenters must remain at their poster on their assigned day during the required hours.
- Each poster will be allocated a 92" wide x 45" high display area (see image to the right). **Please note that your poster can be any size that best displays your work, as long as it fits in this display area.**
- Authors must provide their own velcro hooks or push pins for mounting.
- A (suggested) 8-12-in. high strip at the top of your poster should contain the title of the paper and the name and affiliation of the author(s).
- The poster should have large legible text and figures, and describe the results in a manner that would be clear to a reader in the author's absence.
- Stereo images may be mounted and presented for stereo viewing using viewers provided by the author.



MSA does not permit any type of recording (photography, video, audio, etc.) of lectures, posters, tutorials, workshops and commercial exhibits at the Microscopy & Microanalysis meeting without prior permission of MSA or the individuals concerned.



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Full Symposium Descriptions

- Analytical Sciences Symposia
- Biological Sciences Symposia
- Physical Sciences Symposia
- Cross-Cutting Sciences Symposia

ANALYTICAL SCIENCES SYMPOSIA

A01 - Microscopic Approach of Materials for Agri-Food Process

This session must be aimed at topics related with Materials uses in agro-industrial application for food productivity and conservation; like new era fertilizers, pesticides, growth promoter, materials for food transportation by optimization their unique tagging using microscopic techniques like SEM, TEM, and microscopic observation for structural identification as an artificial intelligence biomarkers (AIB) and there feasibility related aspects and market demands.

Organizers:

H. Javier Anselmo Villegas M., *Universidad Michoacana de San Nicolás de Hidalgo, Mexico*

Lexlie Ileri Rangel Vázquez, *DK-NANOTEC*

Dhirendra Kumar Tiwari, *Cátedras CONACYT / LADIPA-COLMICH, Mexico*

Dhananjay Tripathi, *Institute of Nuclear Medicine and Allied Sciences, DRDO, India*

A02 - Microscopy and Microanalysis for Real World Problem Solving

Microscopy and microanalysis of real world samples present special challenges. Non-ideal samples may not lend themselves to established methodologies for preparation and analysis. Sample amounts and background information about the material and the problem may be limited, and the time frame for producing results may be very short. This symposium will focus on ways in which biologists, physical and materials scientists develop unique and creative solutions for sample preparation, data acquisition and analysis, providing meaningful results to solve problems in the real world.

Organizers:

Ke-Bin Low, *BASF Corporation*

Jeremy Beebe, *The Dow Chemical Company*

Xiaofeng Zhang, *Nanosys*

Abigail Lindstrom, *National Institute of Standards and Technology*

A03 - Standards and Reference Materials and their Applications in Quantitative Microanalysis

Obtaining accurate compositional data by X-ray microanalysis requires the use of well-characterized standards and reference materials. These materials must therefore be compositionally homogeneous, stable, and readily available to the community. In this Symposium, we will discuss the applications and use of standards and reference materials, as well as the development, evaluation, maintenance, and distribution of potential new candidate materials. The techniques covered will include, but are not limited to, EPMA and SEM (both EDS and WDS), SIMS, ICP-MS, XRD, μ XRF, TEM and Raman.

Supported by the FIGMAS FIG

Organizers:

Emma Bullock, *Carnegie Institution for Science*

Will Nachlas, *University of Wisconsin*

Andrw Mott, *Texas A&M University*

A04 - The Praxis of 4D-STEM - Extracting Information from Biological and Functional Materials

4D-STEM has advanced the study of materials at a variety of length scales, from the highest-resolution imaging to millimeter-scale mapping of structures and properties. Recent development of novel 4D-STEM techniques further expands our capability to study beam-sensitive samples, and improvement in saturation current and detector speeds allows for in-situ experiments. This symposium covers the applications of 4D-STEM in the

study of biological and functional materials, and developments of new data analysis methods and best practices to further advance quantitative and multiscale characterization.

Organizers:

Yimo Han, *Rice University*

Colin Ophus, *Lawrence Berkeley National Laboratory*

David A. Muller, *Cornell University*

Weipei Gao, *North Carolina State University*

A05 - Advanced Measurement Techniques in (S)TEM-EELS

Electron energy-loss spectroscopy (EELS) is ubiquitous in most modern (S)TEM instruments and is commonly used to explore local electronic properties and chemistry of materials. This symposium provides a platform for the latest research progress in creative acquisition schemes and associated interpretations of low-loss and core-loss EELS. Topics covered include (not limited to): beam shaping, tuning channeling, orbital mapping, EMCD, momentum-dispersion, temporal resolution, gain spectroscopy, signal-to-noise improvement, event-based detection and damage reduction, unconventional scanning, as well as theoretical approaches and machine-learning processing and interpretation. Contributions where the main focus is the application of novel EELS measurements to (non-)biological materials are encouraged.

Organizers:

Matthieu Bugnet, CNRS, *University of Lyon, France & SuperSTEM Laboratory, UK*

Stefan Löffler, *TU-Wien, Austria*

Armin Feist, *MPI-NAT & University of Göttingen, Germany*

A06 - Learning from Failure: Negative and Null Results in Microscopy

It is no secret that there is a strong bias in science against reporting negative results. While there is much to learn from success, the greatest discoveries often stem from failures. The communication of negative results and artifacts is critical for accelerating scientific progress, yet the current publishing environment rarely rewards such efforts. Whether its rejection by an editor or relegation to the back of the poster hall, scientists have been conditioned to avoid reporting what doesn't work. This symposium is designed as an open, honest, and judgement-free forum for presenting artifacts, mistakes, mishaps, and null results.

Organizers:

Josh Sugar, *Sandia National Laboratories*

Suzy Vitale, *Carnegie Institution for Science*

David Cullen, *Oak Ridge National Laboratory*

A07 - In Memoriam of David Joy: Scanning Electron and Ion Microscopy

This symposium will celebrate the memory of David Joy, who was a pioneer in Scanning Electron and Ion Microscopy and in Monte Carlo simulations of electron trajectories in solids. He made seminal contributions in the theory and measurement of secondary electrons to develop and improve the imaging capabilities of electron and ion microscopes. This also led to seminal contributions in electron metrology related to the semi-conductor industry and low voltage scanning electron microscopy. He was a pioneer in the development of electron channeling imaging in bulk specimens in the SEM, Scanning Transmission Electron Microscopy in the SEM and in the variable pressure scanning electron microscope. He also made several contributions in the field of quantitative x-ray microanalysis with an emphasis on a data base that he updated regularly. He also developed the routine SMART to measure the resolution of SEM images. His contributions are endless. He also wrote several papers and books to explain electron microscopy to the community. But above all of this, he was a real gentleman and a mentor to so many of us. This symposium will be an occasion to remember his seminal work and as well how great he has been for the community.

Organizers:

Raynald Gauvin, *McGill University, Canada*

Dale Newbury, *National Institute of Standards and Technology*

A08 - Advances in Focused Ion Beam Instrumentation, Applications and Techniques in Materials and Life Sciences

This symposium is a platform to provide an overview of recent developments in focused ion beam instrumentation and accessories, as well as a forum for FIB practitioners to share and discuss novel applications and techniques across multiple scientific disciplines. The emphasis is on innovative approaches to imaging, sample preparation, micro/nanofabrication, and analytics that go beyond conventional methods in material and life science research.

Supported by the Focused Ion Beam FIG

Organizers:

Matthew Thorseth, *The Dow Chemical Company*

Lena Wolff, *California Institute of Technology*

KD Derr, *Thermo Fisher Scientific*

A09 - Analytical Scanning Probe Microscopy

Non-e-beam-based, submicron analytical microscopes have undergone astonishing developments. Within scanning probe microscopy (SPM), analytical methods have expanded from mechanical (elastic/dissipative, including controlled rate/temperature) and non-mechanical (van der Waals, electrical/electrostatic, magnetic, thermal) interactions sensed at the tip-sample interface — under optional control of the chemistry or conductivity of the tip and/or immersion environment — to sensing the absorption of IR laser pulses acoustically at the tip or via near-field scattered IR light. Related methods include interferometric optical sensing of IR-excited acoustic pulses and tip-enhanced or confocal Raman microscopy. This symposium seeks to report new findings and foster the cross-discussion of methods.

Organizers:

Greg Haugstad, *University of Minnesota*

Liang Gong, *3M*

A10 - The Road to Atomic Scale Tomography

Atomic Scale Tomography, the ability to identify the location and isotopic identity of every sampled atom in 3-D, will be a reality in the next few years. This symposium will bring together leaders in 3-D atomic scale imaging to discuss what the paths toward AST might entail. Presenters will discuss the state of the art in atomic resolution STEM tomography, analytical STEM tomography, next generation atom probe tomography, and analytical field ion microscopy, among others. Correlating and integrating data from independent modalities will also be discussed with an eye towards AST.

Organizers:

Brian Gorman, *Colorado School of Mines*

Thomas Kelly, *Steam Instruments, Inc.*

Simon Ringer, *University of Sydney, Australia*

A11 - Nanoscale Infrared Spectroscopy with Electrons and Photons

Infrared frequencies of molecular vibrations, phonons, and other quasiparticles (such as plasmons) correspond to free-space photon wavelengths on the scale of micrometers, preventing the study atom- or nano-scale material heterogeneities with conventional far-field infrared spectroscopies. Both optical and electron-based spectroscopic techniques can access these excitations, and each have their own strengths and limitations. Here, we will focus on advanced applications of nanoscale infrared spectroscopy with electrons and phonons, along with theoretical calculations of vibrational properties in heterogeneous systems.

Organizers:

Jordan Hachtel, *Oak Ridge National Laboratory*

Andrea Konečná, *Brno University of Technology*

Rainer Hillenbrand, *CIC-nanoGUNE*

Xingxu Yan, *University of California-Irvine*

A12 - New Methods for Accessing the Structure, Chemistry and Effect on Dynamic Processes of Solid-Liquid Interfaces

Accessing the solid-liquid interface at high resolution is still a challenge in electron microscopy requiring advancements in sample preparation, imaging and spectroscopy and data analysis and visualization. New methods are being developed to characterize the structure, chemistry and dynamics of these interfaces including cryo-FIB lift-out combined with cryo-(S)TEM/EELS, 3D cryo-FIB/SEM combined with EDS and Liquid Phase EM. This session will focus on the development of methods to improve our understanding of solid-liquid interfaces, including the characterization of the catalytic effects of interfaces, and the effect of membranes and interfaces on different dynamic processes and on reaction kinetics.

Organizers:

Patricia Abellan, *CNRS-IMN, Nantes University, France*

Joe Patterson, *University of California-Irvine*

Jennifer Cookman, *University of Limerick, Ireland*

Katherine L. Jungjohann, *National Renewable Energy Laboratory (NREL)*

A13 - Computational Advances in Electron Microscopy

This symposium will focus on the computational advancements made in analyses of electron microscopy datasets, such as new open-source packages or novel analysis algorithms that have applications in the physical and biological sciences. Advancements

made in microscope simulation and data processing routines are also of particular interest. Speed and accuracy improvements in analysis methodologies, especially through machine learning routes are a key focus area for this symposium. Along with the topics mentioned above, this symposium will focus on computational techniques for pushing microscopy into dose-limited regimes, such as those encountered while imaging proteins through cryo-EM and radiation-sensitive material systems.

Organizers:

Debangshu Mukherjee, *Oak Ridge National Laboratory*

Joshua Agar, *Drexel University*

Leopoldo Molina-Luna, *TU Darmstadt, Germany*

A14 - Surface and Subsurface Microscopy and Microanalysis of Physical and Biological Specimens

Surface properties dictate the performance of many physical and biological systems. Surface characterization needs are pushing to detect and image species present in ever-lower concentrations and within ever-smaller spatial and depth dimensions. This symposium emphasizes state-of-the-art surface analytical instrumentation encompassing all aspects of surface and near-surface analyses, such as imaging mass spectrometry, scanning probe microscopy, and other probe-based techniques. We will cover advanced data analysis tools; correlative imaging (e.g., AFM and SEM; AFM and SIMS; FIB-SIMS; APT and TEM) The use of complementary surface instrumentation to perform a complete analysis of complex systems; quantitative microanalysis; data processing; and surface analytical challenges will be highlighted. Both platform and poster presentations are encouraged.

Organizers:

Jeff Fenton, *U.S. Department of Energy*

Xiao-Ying Yu, *Oak Ridge National Laboratory*

Ryan Wagner, *Purdue University*

Vincent Smentkowski, *GE Research*

A15 - Klaus Keil Memorial Symposium: Quantitative Microanalysis of Planetary Materials

In this session, we honor the contributions of Klaus Keil, co-inventor of the energy-dispersive spectrometer, pioneer in quantitative electron-probe microanalysis, leader in scientific investigation of lunar and meteoritic materials, advisor to students, and early

organizer and president of the Microbeam Analysis Society. The session will highlight invited and contributed presentations on quantitative microanalysis of planetary materials, advances in X-ray spectrometry and instrumentation, methods and applications of compositional mapping, advances in microscopy, and new studies of planetary materials including ANGSA Apollo 17 core investigation, Hayabusa2, and preparations for OSIRIS-REx.

Organizers:

Paul Carpenter, *Washington University, St Louis*

Rhonda Stroud, *Arizona State University*

Owen Neil, *University of Michigan*

BIOLOGICAL SCIENCES SYMPOSIA

B01 - Imaging Approaches for Plant Cell Biology, Agriculture, Ecology and Environment-Related Research

Global warming results in a multitude of changes in our environment that deeply impacts all living forms on earth. Many in vitro systems have been developed to study the effect of environmental changes to food crops, plants, insects, aquatic animals and symbiotic ecosystems. This symposium will promote the exchange of knowledge in the development and application of microscopy techniques to study agriculture, ecology and environment-related specimen impacted by external factors. The target audience will include plant and cell biologists, plant pathologist, ecologists, environmental biologists, soil and agricultural researchers interested in technical challenges and opportunities for imaging diverse specimens and their microenvironment.

Organizers:

Kirk Czymbek, *Donald Danforth Plant Science Center*

Marisa Otegui, *University of Wisconsin-Madison*

B02 - 3D Structures: from Macromolecular Assemblies to Whole Cells (3DEM FIG)

Our understanding of the 3D structure and functional subtleties of complex biological systems has skyrocketed due to recent advances in EM imaging technology and hybrid methodologies. This symposium will highlight structural studies of macromolecules, microorganisms, cells, and tissues using state-of-the-art high-resolution techniques.

These techniques include single particle cryo-EM, cryo-electron tomography, helical reconstruction, STEM; AFM, X-ray crystallography, and molecular modeling. Biological topics of interest include cellular architecture, metabolism, trafficking, communication, and division; gene regulation, transcription, and translation; host-pathogen interactions and virus structure; in situ studies using TEM and SEM, and all aspects of structure-function studies of biological assemblies.

Supported by the 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*

B03 - Machine Learning in Biological Imaging – How to Train Your Artificial Neural Network

Developments in machine learning applied to microscopy have been rapidly progressing, largely due to the improving computational and data acquisition capabilities. Admittedly, this area is currently dominated by advances in the material sciences field, but this symposium will showcase the successes of ML in biological applications. We invite presentations addressing novel data-driven AI/ML methods in all areas of life sciences, including applying ML methods for various microscopy imaging strategies to achieve automated characterization of selected features and identifying collective variables for obtaining (ultra)structural datasets, ultimately for predictive understanding of features and processes in various biological systems.

Organizers:

Alice Dohnalkova, *Pacific Northwest National Laboratory*

Kyle Harrington, *Chan Zuckerberg Initiative*

Kasia Kedziora, *University of Pittsburgh*

Neerja Zambare, *Pacific Northwest National Laboratory*

B04 - Development, Challenges and Biomedical Applications of Tissue Clearing, Super-resolution Microscopy and Tissue Imaging

Microscopes are essential tools for studying biological specimens, but their utility is often limited by the preparation of the tissue to be imaged. Advances in tissue preparation technologies, such as tissue clearing and Expansion Microscopy, facilitate more effective

visualization and understanding of structures and processes in intact biologic systems. Innovation in the way that tissues are manipulated prior to imaging often spurs novel uses for established imaging platforms and may inspire the development of new hardware and computational approaches. This symposium offers the opportunity to explore advancements in tissue preparation and high throughput tissue imaging technologies which push the limits and expand the utility of modern light microscopes. Target attendees include scientists from all levels of bio-imaging expertise and related backgrounds.

Organizers:

Yongxin Zhao, *Carnegie Mellon University*

Alan M. Watson, *University of Pittsburgh*

Adam Glaser, *Allen Institute for Neural Dynamics*

B05 - Technical Advances in cryoEM

Technical advances in cryoEM are continuing at breakneck speed, with innovations in hardware and software making new kinds of experiments possible and increasing existing protocols' robustness, performance, and/or throughput. Speakers involved in methods and hardware development will be invited to illustrate these cutting-edge developments and discussions on future needs and directions of the fields will be fostered.

Organizers:

Alexis Rohou, *Genentech*

Christopher Russo, *MRC Laboratory of Molecular Biology, UK*

Anchi Cheng, *New York Structural Biology Center*

Timothy Grant, *Morgridge Institute*

B06 - Innovations in Light Microscopy: Revealing the Inner Workings of Life from Single Molecule to Whole Organisms

This symposium presents developments on three important frontiers that have recently transformed optical imaging, including (i) the various methods in breaking the diffraction limit to achieve super-resolution microscopy and their applications to living samples, (ii) the renaissance of correlative imaging, pairing these techniques with electron microscopy, functional imaging etc and (iii) the development of novel reagents and sample labeling strategies that are providing unprecedented capabilities for the visualization of structure and function within biological systems. These technologies have in turn ushered in an era of big data and promises to image life on scales previously thought impossible. In this

symposium, we aim to highlight the exciting possibilities and hurdles faced by modern optical microscopy. In addition, the symposium will cover new developments and techniques used to image life as never before.

Organizers:

Jay Potts, *University of South Carolina*

Rengasayee (Sai) Veeraraghavan, *The Ohio State University*

B07 - Electron and Light Microscopy Research and Diagnosis of Diseases in Humans, Animals and Plants

Electron and light microscopy (EM and LM) are critically important techniques in the ongoing research, detection, diagnosis, and treatment of diseases. The application of microscopy techniques to study genetic, metabolic, or infectious diseases, and advances involving correlative microscopy techniques are faced with many challenges including specimen preservation, sample preparation, data collection and quantitative analysis. This symposium invites contributions in diagnostic and research from scientists with all levels of bio-imaging expertise and related backgrounds, to come together and discuss a diverse content related to microscopy research and diagnosis of diseases in human, animal and plants.

Supported by Diagnostic & Biomedical Microscopy FIG

Organizers:

Marcela Redigolo, *West Virginia University*

Claudia López, *Oregon Health & Science University (OHSU)*

Emily Benson, *Cleveland Clinic*

B08 - Biological Soft X-ray Tomography

This symposium is a forum for the exchange of information and knowledge on the latest advances in soft X-ray tomography instrumentation and methods for imaging biological specimens. Soft X-ray tomography is a label-free technology for quantitative imaging of fully hydrated, intact cells in 3D. Invited papers will demonstrate the diverse applications in the biosciences and the technical advances in specimen preparation, data processing and reconstruction, and imaging formation theory that made them possible. Target audience will include cell biologists, and scientists and engineers interested in novel microscopies, including correlative cryo light and structural cell imaging methods.

Organizers:

Kenneth Fahy, *SiriusXT*

Carolyn Larabell, *University of California-San Francisco*

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

Volume Electron Microscopy (vEM) techniques such as serial block face scanning electron microscopy (SBF-SEM), focused ion beam scanning electron microscopy (FIB-SEM), array tomography (AT) and serial section electron tomography (ssET) are crucial to correctly interpret ultrastructure of cells and tissues in three dimensions and are increasingly being combined with other imaging modalities to produce richly contextualized datasets. This symposia will focus on sample preparation, application of current vEM acquisition techniques, and instrument and technique development in the volume imaging space. Given the daunting issues that can arise in post-acquisition data processing, the symposia will also address issues and solutions in the correlation of disparate, multi-scale and multi-mode data streams, the portability of automation, as well as analysis and visualization.

Organizers:

Alice Liang, *New York University Langone Health*

Camenzind G. Robinson, *St. Jude Children's Research Hospital*

Paul Verkade, *University of Bristol, UK*

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

Microscopy and microanalysis, including both TEM and SEM, have been widely used in biological and/or materials sciences to acquire information on samples' morphological features, chemical composition and crystal structure. These applications often involve characterization of both organic and inorganic matter in the same samples, especially interfaces and interactions between organic and inorganic matter. Organic and inorganic interfaces and interactions exist not only in nature between bone and muscle, enamel and dentin, and during biomineralization and biocorrosion, but also in synthetic or engineered materials, such as biomaterials and devices implanted in the human body as well as hybrid materials for optical, electronic, energy and medical applications. The proposed symposium sessions will cover applications of integrated microscopy and microanalysis techniques in characterizing organic and inorganic interfaces and interactions.

Organizers:

Donggao Zhao, *University of Missouri-Kansas City*

Hailiang Dong, *China University of Geosciences – Beijing*

Nan Yao, *Princeton University*

INTERDISCIPLINARY (CROSS-CUTTING) SYMPOSIA

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

The scientific community is reimagining how microscopy may be used for the discovery and design of material, chemical, and biological systems. We are grappling with how to meaningfully deploy emerging artificial intelligence, machine learning, and modular hardware technologies for more powerful, resilient, and sustainable microscopy. In this symposium we will explore emerging reconfigurable, reprogrammable, or tunable instrument architectures, new modes of automated and remote operation, and provide critical dialogue on the growing divide between cost-driven technological "haves" and "have-nots," among other topics. We will consider the end-to-end efficiency of investigations; including, sharing of samples and results, collection of useful coincident signals, and the safe reuse of open datasets.

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*

C02 - Extracting Information from Data: Applications of Artificial Intelligence in the Materials and Biological Sciences

The adoption and exploitation of advanced data analysis techniques enabled by machine learning and artificial intelligence methods continue to impact electron microscopy dramatically. Furthermore, the advent of multiple new types of advanced electron detection methods necessitates automated and real-time data analysis. Many of these developments are happening within the broader framework of open-source software

development and can exploit open data. These developments are intertwined with issues regarding adherence to Findable, Accessible, Interoperable, and Reusable (FAIR) data principles.

Organizers:

Peter Ercius, *Lawrence Berkeley National Laboratory*

Eric Stach, *University of Pennsylvania*

Kevin Roccapiore, *Oak Ridge National Laboratory*

C03 - Correlative and Multimodal Microscopy and Analysis

Real-world systems are hierarchical, encompassing large differences in size, structure, composition and arrangement. Correlative microscopy and analysis have evolved to an essential toolkit to characterize these complex systems and have led to advances in both soft and hard material studies by providing information with complimentary modalities and across different scales. In this symposium, we highlight technical innovations in instrument development, sample preparation and handling, in-situ and cryogenic sample environment, and data analysis pipeline. We also seek contributions on applying correlative methods to physical, environmental, biological and biomedical studies.

Organizers:

Si Chen, *Argonne National Laboratory, USA*

Xiao-Ying Yu, *Oak Ridge National Laboratory, USA*

Raul Arenal, *University of Zaragoza, Spain*

Nestor Zaluzec (mailto:anl.nestor.zaluzec@gmail.com), *Argonne National Laboratory, USA*

C04 - Lens on Diversity in the Microscopy and Microanalysis Community

This session will serve as a forum for discussion of the state of the profession of microscopy and microanalysis with invited and contributed posters that address: work by women and underrepresented minority microscopists; demographics and statistics regarding the current M&M community; strategies for a fostering a more inclusive community; and visions for expanding engagement to build a bigger, better future for the M&M community.

Organizers:

Rhonda Stroud, *Arizona State University*

Shery Chang, *University of New South Wales, Australia*

Molly McCartney, *Arizona State University*

Treva Brown, *Naval Research Laboratory*

C05 - Vendor Symposium

PHYSICAL SCIENCES SYMPOSIA

P01 - Revealing the Working Morphology of Energy Materials and Its Impact on Performance

To address material challenges in energy conversion and storage technologies, we need insights into the functional morphology of materials under reaction conditions. This symposium focuses on research using cryo-, in-situ, or operando microscopy to capture changes in the structure and chemistry of energy materials during operation in a time-resolved manner and experimental approaches for relating these observations to their impact on bulk properties. We welcome contributions using correlative methods to probe these materials over multiple length scales or applying data science to extract structure-property correlations. Student submissions that discuss how to address the technical challenges of such experiments are encouraged.

Supported by Electron Microscopy in Liquids and Gases FIG

Organizers:

See Wee Chee, *Fritz Haber Institute of the Max Planck Society, Germany*

Stephen House, *Sandia National Laboratories*

David Wei-Chang Yang, *National Institute of Standards and Technology*

Kinga Unocic, *Oak Ridge National Laboratory*

P02 - Atomically Precise Manipulation of Materials

Atomically precise manipulation was first achieved with scanning probe microscopies, which continue to produce important advances using surface atoms and vacancies. However, recent developments in scanning transmission electron microscopy (STEM) instrumentation have made it possible to focus electron beams with sub-atomic precision, opening up new possibilities for manipulating strongly bound materials, including in the bulk. At the same time, other charged particle beams, including helium ion microscopy, have been added to the scientific arsenal, and advances in atomistic

modeling and theory have elucidated new details of the beam-matter interaction, helping guide experiments. These breakthroughs have led to a series of studies on the controlled structuring, etching, deposition, phase change, and ultimately manipulation of individual atoms. This symposium will gather leading experts from this new frontier of materials science, including advances in machine learning and artificial intelligence, with a focus on atomic-level control.

Organizers:

Toma Susi, *University of Vienna, Austria*

Andrew Lupini, *Oak Ridge National Laboratory*

Demie Kepaptsoglou, *University of York, UK*

Quentin Ramasse, *SuperSTEM Laboratory, UK*

P03 - Theory and Applications of Advanced Electron Tomography

Transmission electron microscopy (TEM) and scanning TEM (STEM) reveal the structure of materials across the nano-scale with achievable resolutions below one Ångstrom. However, these are only two-dimensional (2D) projections of complex three-dimensional (3D) structures. 3D morphology and composition are critical to determine the function of nano-structures used across many fields, such as energy, catalysis, electronics, and quantum materials. The success of electron tomography has fueled rapid innovation in quantitative, sub-nanoscale 3D analysis in electron microscopy that include recent achievements of atomic resolution and methods to determine 3D structure from few (even a single) projection image.

Organizers:

Robert Hovden, *University of Michigan*

Mary Scott, *University of California-Berkeley*

Peter Ercius, *Lawrence Berkeley National Laboratory*

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

Metals, ceramics, concrete, and polymers are being used in diverse additive manufacturing (AM) applications. Parts and components processed through these incremental layer-by-layer manufacturing techniques have microstructures that depend on a variety of factors like directed power source (e.g. laser or electron beam, arc-discharge), processing parameters (dwell, shape/contour region), choice of feedstock materials and post fabrication treatments. With modeling guided experimental control, site specific material

properties can be engineered in AM parts because control of microstructure in pre-defined areas can be achieved. Contributions are invited on research of microstructures in additively manufactured components at multiple length scales through multi-modal microscopy/microanalysis characterization techniques, including OM, FESEM/EBSD/EDS/TKD, AEM, STEM, EELS, APT, EPMA and XCT. Correlation of microstructures to process conditions and final component properties are encouraged.

Organizers:

Donovan Leonard, *Microsoft*

Sarshad Rommel, *University of Connecticut*

Sriram Vijahan, *The Ohio State University*

Cain Hung, *Collins Aerospace*

P05 - Microscopy and Microanalysis of Materials under Multiple Environmental Extremes

Future energy systems will expose materials to multiple extreme environments, often simultaneously, such as high temperatures, stress/strain, radiation, and corrosion/oxidation. When applied concurrently, these synergistic interactions can lead to unique material responses not found from sequential application of the same conditions. Understanding the mechanisms of materials' responses to multiple extremes therefore requires advanced characterization/testing, including in-situ analyses of separate and combined stimuli. This symposium will bring together experts in radiation effects, corrosion, mechanical behavior, and advanced microscopy, with an emphasis on the application of latest-generation methods of microscopy, microanalysis, and data analytics to tackle problems in materials under coupled extremes.

Organizers:

Timothy Lach, *Oak Ridge National Laboratory*

Yuan Yuan Zhu, *University of Connecticut*

Daniel Schreiber, *Pacific Northwest National Laboratory*

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

The performance and degradation of materials used in nuclear environments is critical to the economics and safety of existing and advanced fission and fusion reactors. Microscopy techniques is among the most effective methods to establish microstructure-property relationships, in order to understand various effects, such as irradiation, corrosion, and high temperature, in these materials. Investigations on how extreme environments in

nuclear environments interact and impact microstructure, and thus properties, can lead to developments of advanced materials, and better estimation of materials' service lifetime, etc. This symposium will focus on recent results produced from materials for nuclear applications advances made in microscopy, with an emphasis on application of latest-generation methods of microscopy and microanalysis.

Organizers:

Jing Wang, *TerraPower*

Assel Aitkaliyeva, *University of Florida*

Mukesh Bachhav, *Idaho National Laboratory*

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

This symposium will recognize and honor the distinguished career of University of Michigan Emeritus Prof. Wilbur C. Bigelow, MAS "Legend" and MSA Fellow, who turns 100 years old early in 2023. We invite submissions from former students and collaborators, as well as researchers working broadly in the area of in situ heating and gas reaction studies, topics of his interest over the past 15 years. Bigelow joined EMSA in 1950 and served in many roles including President in 1969, when the annual meeting was also held in Minneapolis. He taught his electron microscopy course for 35 years at Michigan. The techniques of in situ heating and gas reactions have evolved considerably from the mid 1960s when Bigelow studied the oxidation of Cu single crystal films using a JEOL JEM-6A with a 16-mm cine film camera. In retirement, Bigelow became active in designing specialized equipment for microscopy, and he collaborated into his 90s in pioneering the development of closed-cell gas-reaction techniques that are currently popular in the field. This symposium will feature talks and posters in the general areas of in situ heating and gas reactions (utilizing both closed-cell specimen holders and differentially pumped E-TEM techniques), all for materials science applications.

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)*

P08 - Atomic Scale Microscopy of Interfaces and Heterostructures with Correlated Phenomena

This symposium focuses on novel properties and emergent phenomena at interfaces and heterostructures for next generation spintronics and quantum computing. Topics will include transmission electron microscopy (or any related techniques) that provides the atomic scale details that correlate to charge, spin, magnetic, topological, and/or quantum phenomena. For example, (i) Microscopy of atomic structure at the interface that relates to interfacial interaction, proximity effect, charge transfer, and/or magnetic ordering, (ii) Interfaces and heterostructures that consist of strongly correlated materials, ferroelectrics and multiferroics, (anti)ferromagnetic insulators, low dimensional materials and/or Van der Waals interface, and (iii) Characterization of atomic scale structure that bridges condensed matter theory and property measurements of novel interfaces and heterostructures.

Organizers:

Jinwoo Hwang, *Ohio State University*

Menglin Zhu, *Ohio State University*

Salva Salmani Rezaie, *Ohio State University*

P09 - Advances in Cryogenic Transmission Electron Microscopy and Spectroscopy for Quantum and Energy Materials

This symposium is intended to facilitate the exchange of information on the latest developments, challenges, and outlooks in cryogenic-S/TEM and electron spectroscopy to probe phenomena in quantum and energy materials. Utilising cryogenic conditions has allowed researchers to start exploring beam sensitive and liquid phase interfaces found in energy materials and devices such as batteries at the atomic-scale. More recently temperature controlled cryogenic-S/TEM hardware is enabling researchers to explore in-situ low temperature quantum phases. We welcome contributions in theoretical and data analysis techniques including AI/ML approaches that are essential to overcome the low signal/noise and instrumentation stability constraints common to cryogenic-S/TEM.

Organizers:

Michele Conroy, *Imperial College London, UK*

Ismail El Baggari, *Harvard University*

Miaofang Chi, *Oak Ridge National Laboratory*

P10 - Advanced Imaging and Spectroscopy for Nanoscale and Sensitive Materials

Scanning and transmission electron microscopy has been a powerful tool to gain new knowledge of nanoscale materials and interfaces with unprecedented resolution in space, energy, and time domain. Recent developments in aberration-correction, monochromation, and high-speed, high-sensitivity spectrometers and cameras have enabled advanced imaging and spectroscopy methodologies to probe materials structure and chemistry under in situ and operando experimental conditions. Such capabilities offer a unique perspective to understand the structure-property relationships from the atomic-scale for a large variety of nanomaterials and to overcome the challenges in beam sensitive materials, such as solid-electrolyte interphase in batteries, hybrid organic-inorganic halide perovskites, low-dimensional quantum materials, and soft-hard interfaces. This symposium will focus on the latest progress in advanced imaging and spectroscopy techniques that address the pressing challenges and solve fundamental questions for nanoscale and sensitive materials.

Organizers:

Kai He *University of California-Irvine*

Meng Gu, *Southern University of Science and Technology, China*



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Microscopy Outreach

X90: Microscopy in the Classroom

Organizers:

Josh Silverstein, Pacific Northwest National Laboratory

Rengasayee (Sai) Veeraraghavan, The Ohio State University

At the frontiers of science, the microscope is an interdisciplinary tool which allows students to glimpse into the unknown and link structure and function. The Education Outreach Committee of MSA seeks to connect individuals and institutions and ensure that the pathways to microscopy careers and education are exciting, engaging and clear.

- Best practices for incorporating microscopy into K-12 and post-secondary classrooms and curricula.
- Local and national initiatives emphasizing STEM education and outreach.
- Methods to expose students to microscopy in a fun, engaging and impactful manner.

X91: Microscopy Explorations for Families and Kids of All Ages

(formerly "Family Affair")

Please check back on the M&M 2023 website ("Scientific Program" – "Microscopy Outreach") for updated information about this session.

X92: Project MICRO

The Outreach booth is part of the MSA Megabooth and is available every day the exhibit hall is open. Learn how to set up different stations in a classroom and share your fun microscopy outreach classroom experiences! See different microscope systems in action for use in a classroom; peruse a selection of books suitable for elementary school-age children; and put your name into the draw for a daily door prize.

All are welcome including delegates family and friends!

X93: High School & Undergraduate STEM Student Workshop

Organizer:

Josh Silverstein, Pacific Northwest National Laboratory

High school and undergraduate STEM students attend a day-long workshop at an area university, then attend a full day of M&M 2023 to get experience with professional learning and activities. Students will present original research during the poster presentation on Monday in the exhibit hall.

Please check back frequently on the M&M 2023 website as additional information becomes available.

X94: STEM Roundtable: Building Skills for the Future

Organizer:

Lori Harvey, Hitachi High Technologies America

We will explore how to integrate varied resources to have broader, sustainable impacts in STEM education, including bridging K-12 outreach with undergraduate and graduate education, and emphasizing the importance of diversity and inclusion which will lead to a stronger workforce for everyone.

Session is open to all — no separate registration fee required.



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Plenary Session Speakers

Karin Sauer, PhD

Professor and Chair

Department of Biological Sciences, Binghamton University

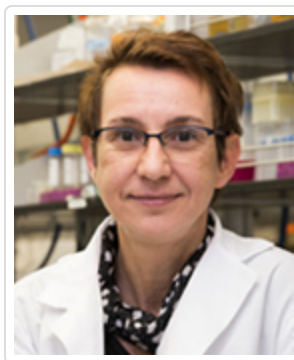
Co-Director, Binghamton Biofilm Research Center (BBRC)

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. 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.



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Pre-Meeting Congresses

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

(/MandM/2023/program/congress_x60.cfm)

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

X61 — Advances in Focused Ion Beam Technologies

(/MandM/2023/program/congress_x61.cfm)

Organized by the MS AFIB Focused Interest Group

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

(/MandM/2023/program/congress_x62.cfm)

Organized by the MSA Facilities Operation and Management Focused Interest Group

X63 — Imaging in the Pharmaceutical, Biopharmaceutical, and Medical Health Products Industry (/MandM/2023/program/congress_x63.cfm)

Organized by the M&M Pharma Focused Interest Group

X64 — Hardware and Software Developments in Electron Microscopy

(/MandM/2023/program/congress_x64.cfm)

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



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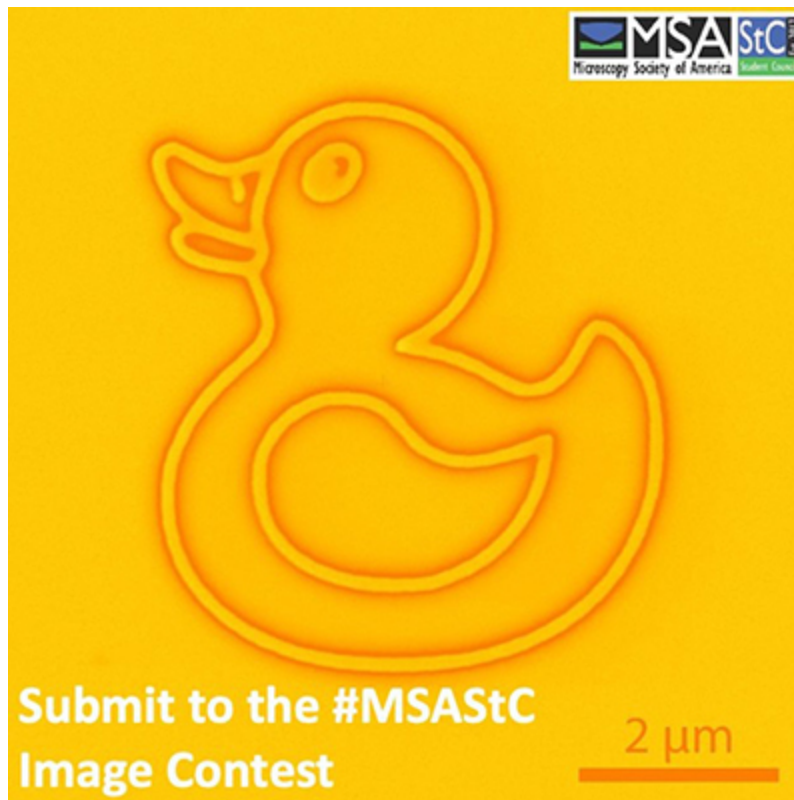
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X60 — Annual Pre-Meeting Congress for Students, Post-Docs, and Early-Career Professionals in Microscopy and Microanalysis

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

Saturday, July 22, 2023 • 8:15 AM - 5:00 PM

Want a free PMCx60 Registration?



Submit to the StC image contest (<https://forms.gle/ZmSf91rFZKAyJBBMA>)! The winner's PMC registration fee will be waived, and their image will be used as the new background on next year's StC flyer advertisements.

Submission deadline is Friday, July 1st!

Separate registration required — Don't forget to check the box while registering for M&M 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 LIAISON: Neerja Zambare, Pacific Northwest National

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

- Technical workshops from leading industry experts
- A forum for students to deliver presentations to peers ahead of the meeting
- Career guidance from established researchers in academia, industry, and national labs
- Overview of career trajectories for postdocs, and tackling the transition between fields
- Mentoring and recruiting opportunities for early-career professionals
- Opportunities to share your research in an engaging, constructive, and interactive setting to practice ahead of the main meeting and win awards
- Expanded professional networking and career development mentoring

What's Next?

Navigating opportunities for your future in science

Friday, July 21, 2023

6:00 – 8:00 pm Welcome Reception at **Lakes and Legends Brewery:**
1368 Lasalle Ave

Saturday, July 22, 2023

Welcome

8:15 – 9:00 am Breakfast provided

9:00 – 9:30 am Opening remarks
Andrew Minor, MSA President
Patrick Camus, MAS President

Introduction to MSA StC
Louisa Mezache, StC President
Andres Marquez-Rossy, StC President-Elect

Student Research Talks

9:30 – 10:15 am Student Research Talks

10:15 – 10:30 am Early Career Professionals Flash Talks

10:30 – 11:15 am Poster Session and Break: refreshments provided

Physical Sciences Workshop / Biological Sciences Technical Talks

11:15am – 12:15 pm Technical talks / workshops

12:15 – 1:15 pm Lunch provided

Biological Sciences Workshop / Physical Sciences Technical Talks

1:15 – 2:15 pm Technical talks / workshops

2:15 – 3:00 pm Poster Session and Break: refreshments provided

Career Workshop

3:00 – 5:00 pm Career Session with group photo to end

Dinner

6:30 – 9:30 pm Saturday night banquet at **Paradise Charter Cruises:
2150 West River Pkwy**

Submit Today!

Apply for the PMCx60 Scholarship (<https://forms.gle/srkSBKGs3mecQSDr9>)

The PMCx60 organizers are pleased to offer financial support to qualifying PMCx60 registrants. All PMCx60 registrants are welcome to apply. The awards will be granted primarily on the basis of financial need — those who are unable to attend the PMCx60 without financial aid will be prioritized.

There is a limited number of awards available that will cover costs associated with attending PMCx60 up to \$500 to be reimbursed after the meeting. Early Rate registration ends on May 4 and Regular Rate registration ends June 9, so register now!

Submit a poster for PMCx60 (<https://forms.gle/kwhdaViGNZP3YY4v5>)

We are now accepting submissions to the poster session at PMCx60. This is a great opportunity to showcase your work and practice your presentation in a more informal setting ahead of the main meeting. We will also be offering a number of speaker prizes! If you have any questions feel free to reach out to the PMCx60 chair, Louisa Mezache, mezache.2@osu.edu (<mailto:mezache.2@osu.edu>).

The Microscopy Society of America Student Council invites you to

PMCx60 – Pre-Meeting Congress for Students, Post-Docs, and Early-Career Professionals

**check YES
when
registering
for M&M!**

Apply for the PMCx60 scholarship

- Up to **\$500** to offset PMCx60 travel and registration costs

Submit a poster for PMCx60

- Win **prizes** and **practice** your presentation ahead of the main meeting



X-60 Pre-Meeting Congress for Students, Post-Docs, and Early-Career Professionals



PMCx60 Programming Committee | 2022 – 2023

Louisa Mezache	The Ohio State University	StC President
Andres Marquez-Rossy	University of Tennessee, Knoxville	StC President-Elect
Yifan Wang	Arizona State University	Physical Sciences Co-chair

Ayanthi Thisera	University of Kentucky	Social Chair
Neerja Zambare	Pacific Northwest National Lab	Post-doc Liaison

A note from the organizers

Thank you for attending this year's PMCx60! Our mission for this event is to provide an opportunity for students, post-docs, and early career scientists to expand their professional network, share knowledge and learn about different career paths. We welcome attendees from all backgrounds, professional and personal, and hope that this event serves as a fun, energetic start to a productive week at M&M 2023! We would like to acknowledge our generous donors who have contributed to the MSA Student Council during the 2023 membership renewal drive.



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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)

INCLUDED IN REGISTRATION FEE:

AM Break, Lunch

PROGRAM CHAIR:

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



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X64 — 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



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M&M 2023 — Post-Deadline Poster Abstracts

Poster Number	Paper Title	Presenter Name
PDP-1	Microstructural Origin of Hardness in Flash-Butt Welded Rails (abstracts/pdp-1.pdf)	Heshmat Aglan (mailto:haglan@tuskegee.edu) Tuskegee University
PDP-2	Non-destructive imaging of polar domains and crystallographic symmetry in the scanning electron microscope (abstracts/pdp-2.pdf)	Yu-Tsun Shao University of Southern California
PDP-3	Empowering Cryo-EM Research: Introducing a Customizable, Modular Freezing System with High-Precision Robotics (abstracts/pdp-3.pdf)	Wyatt Peele (mailto:venkata.dandey@nih.gov) NIH
PDP-4	Influence of Excess Silicon on the Nucleation of Zincblende vs. Wurtzite GaN Nanowires (abstracts/pdp-4.pdf)	Abby Liu University of Michigan
PDP-5	Strategies and best practices to improve the success rate of Cryo-EM sample (abstracts/pdp-5.pdf)	Mahfuz Rahman Thermo Fisher
PDP-6	TEM Characterization of Deflected Crack in TREAT Irradiated SiC f/SiC Accident Tolerant Fuel Cladding (abstracts/pdp-6.pdf)	Mario Daniel Matos INL
PDP-7	Suspected Coupling of Dark Plasmonic Modes in Bilayer CdO (abstracts/pdp-7.pdf)	Caleb Whittier (mailto:mjlagos@mcmaster.ca) McMaster University

PDP-8	Characterization of polycrystalline diamond/Si heterostructures using STEM-EELS	Ramandeep Mandia Arizona State University
PDP-9	Ultra Low-Temperature TEM Sample Holder with High Stability Over Long Hold Times (abstracts/pdp-9.pdf)	Maya Gates University of Michigan
PDP-10	Time-resolved cathodoluminescence: measuring dynamics at the nanoscale (abstracts/pdp-10.pdf)	Herman Duim
PDP-11	Ultrastructural Responses Curly Top Virus Infection in Different Plant Hosts (abstracts/pdp-10.pdf)	Batool Al-Khatib
PDP-12	Efficient Workflows for Electron Microscopy Laboratories by Using Automated Specimen Preparation (abstracts/pdp-12.pdf)	Steven Goodman Microscopy Innovations
PDP-13	Comparing lead- and copper-chalcogenide nanocrystal size distributions in isolated and aggregated environments with watershed- and intensity-based classification in an interactive user-based environment (abstracts/pdp-13.pdf)	Todd Brintlinger Naval Research Lab
PDP-14	Non-aqueous Ultra-microtome of Cesium Lead Halide Perovskite Crystals for Defect Analysis (abstracts/pdp-14.pdf)	Kyle Sendgikoski (mailto:kyle.sendgikoski.ctr@nrl.navy.mil) Naval Research Lab
PDP-15	Unsupervised and semi-supervised classification of order-disorder phase transitions in oxides (abstracts/pdp-15.pdf)	Arman Ter-Petrosyan PNNL
PDP-16	Plunger-robot for blot-free preparation of cryo-EM samples with controllable film thickness and real-time optical process control (abstracts/pdp-16.pdf)	Michael Schwertner Linkam Scientific Instruments
PDP-17	Development of FIB-TEM Linkage Air-isolated Cooling Holder for High Resolution TEM/STEM Analysis (abstracts/pdp-17.pdf)	Akinari Hanawa Hitachi

PDP-18	Charge modulations in nanostructures revealed by 4D-STEM (abstracts/pdp-18.pdf)	Miyoung Kim Seoul National University
PDP-19	Dose-efficient tcBF-STEM for imaging frozen-hydrated biological specimens (abstracts/pdp-19.pdf)	Yue Yu Cornell University
PDP-20	Damage Mechanism and Defect Evolution of Hybrid Perovskite FAPbI₃ Under a Variable Dose Electron Beam (abstracts/pdp-20.pdf)	Yuxi Zhang (mailto:nua10@psu.edu) Penn State University
PDP-21	Milling method to achieve both widening of planar surface milling area and reduction of curtaining effect in processing (abstracts/pdp-21.pdf)	Yuji Hasebe (mailto:yhasebe@jeol.co.jp) JEOL
PDP-22	Unveiling Mechanisms of Common Kingfisher's Non-Iridescent Structural Colors and Proposing Innovative Biomimetic Approaches (abstracts/pdp-22.pdf)	Jihun Kang (mailto:jongsoukyeo@yonsei.ac.kr) Yonsei University
PDP-23	Time Correlation between Electrons and X-rays in TEM with Nanoseconds Resolution (abstracts/pdp-23.pdf)	Daen Jannis (mailto:Daen.Jannis@uantwerpen.be) University Antwerp
PDP-24	Optimization of strategies for improved immunolocalization and morphology for correlative light and electron microscopy in plant tissues (abstracts/pdp-24.pdf)	Anastasiya (Nastia) Klebanovych Danforth Center
PDP-25	Prepare samples at maximum throughput and with artifact-free surfaces using high current plasma FIB-SEM (abstracts/pdp-25.pdf)	Martin Sláma (mailto:martin.slama@tescan.com) Tescan
PDP-26	Enhancing sample preparation for in-situ heat treatment of Al-Mn-Cr-Zr based alloys in synchrotron studies for additive manufacturing with plasma FIB-SEM technology (abstracts/pdp-26.pdf)	Martin Sláma (mailto:martin.slama@tescan.com) Tescan
PDP-27	Geometric Control of Cell Behavior by Biomolecule Nanodistribution (abstracts/pdp-27.pdf)	Martin Sláma (mailto:martin.slama@tescan.com) Tescan

PDP-28	Multimodal electron microscopy for unravelling structure-coherence relationship in superconducting quantum materials and systems (abstracts/pdp-28.pdf)	Thang Pham Northwestern University
PDP-29	Multiscale imaging and computational modeling for understanding thick cathode degradation mechanisms (abstracts/pdp-29.pdf)	Herman Lemmens Thermo Fisher
PDP-31	High-Resolution S_TEM Imaging and Cathodoluminescence of 2D TMD Heterostructures (abstracts/pdp-31.pdf)	Anuj Bisht (mailto:nua10@psu.edu) Penn State University
PDP-32	Role of VEGF Inducer GS4012 on Blood Vessel Formation and Regeneration as Assessed by Low Magnification Microscopy in Live Larval Axolotls (abstracts/pdp-32.pdf)	Malikeya Chaudhary (mailto:rdickie@towson.edu) Towson University
PDP-33	Electrical and Compositional Investigation of the Effects of Post-Deposition Treatments on CIGS Thin Film Solar Cells (abstracts/pdp-33.pdf)	Marzieh Bann Ohio State University
PDP-34	SEM-Based Morphological Analysis of Schistocerca gregaria: The Arizona Desert Locust (abstracts/pdp-34.pdf)	Ben Wenig American University
PDP-35	Understanding the influence of beam mechanics in photothermally excited Atomic Force Microscopy imaging techniques (abstracts/pdp-35.pdf)	Ryan Wagner Purdue University
PDP-36	FRET spectrometry experiments and MD simulations-based modeling reveal details in oligomerization of a prototypical GPCR (abstracts/pdp-36.pdf)	Dammar Nath Badu Univ of Wisconsin-Milwaukee
PDP-37	Distinct morphology of immature HIV-2 particles as revealed by cryo-electron tomography (abstracts/pdp-37.pdf)	Willaim Arndt University of Minnesota
PDP-38	Fabrication of epitaxial AlGaSb quantum dots on GaSb substrate by utilizing Ga focused ion beam (abstracts/pdp-38.pdf)	Daniel Perry Sandia National Labs

PDP-39	Measuring aberrations from HRTEM images of crystal lattice via using machine learning algorithms (abstracts/pdp-39.pdf)	Fang Lin
PDP-40	Effect of Shot Peening on the Microstructure of Various Ferrous Alloys (abstracts/pdp-40.pdf)	Keesam Shin
PDP-41	Controlling the biochemistry on-the-fly and visualizing reaction dynamics during in situ Liquid Phase TEM_A strong tool for biopharmaceutical development (abstracts/pdp-41.pdf)	Hans Radhoe DENS Solutions
PDP-42	High Quality 2D microstructural characterization of a cycled Li-battery cell structure using CleanConnect (IGST) from BIB to SEM (abstracts/pdp-42.pdf)	Brandon Van Leer Thermo Fisher
PDP-43	In Situ Snapshots Along a Mammalian Selective Autophagy Pathway (abstracts/pdp-43.pdf)	Meijing Li
PDP-44	Ultrastructural Characterization of Morphogenesis of SARS-CoV-2 in an In Vitro System (abstracts/pdp-44.pdf)	Debora Ferreira Barreto Vieira
PDP-45	Nanogalvanic corrosion observed in pearlitic steel via in-situ liquid-cell electron microscopy (abstracts/pdp-45.pdf)	Steven Hayden
PDP-46	In situ structures of type II secretion system secretins reveal their membrane translocation process (abstracts/pdp-46.pdf)	Zhili Yu (mailto:zhaow@bcm.edu)
PDP-47	Cryo-Electron Microscopy Investigation of Polyacene Using Direct Electron Detection Technology (abstracts/pdp-47.pdf)	Haw-Tyng Huang Stonybrook University
PDP-48	Multi-modal spectroscopic characterization and defect detection in SnO₂ / Ga₂O₃ nanostructures (abstracts/pdp-48.pdf)	Praveena Manimunda Horiba

PDP-49	Analysis of Helium-Irradiated Lunar Pyroxene Analogue by STEM-EELS (abstracts/pdp-49.pdf)	Brittany A. Cymes NASA
PDP-50	CryoEM plant membrane protein (abstracts/pdp-50.pdf)	Lynnicia Massenburg Penn State University
PDP-51	Cryo-EM protein structure without purification (abstracts/pdp-51.pdf)	James Evans PNNL



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Sunday Short Courses

X-10 High-Resolution Structure Determination by Cryo-EM

LEAD INSTRUCTOR:

Tim Grant, *Morgridge Institute / University of Wisconsin-Madison*

- Cryo-EM specimen preparation
- Introduction to TEM
- Single-particle data collection
- Single-particle image processing
- Validation of results

X-11 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

X-12 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 Danforth Plant Science Center*

This course is the second installment of a two-part series of biological EM course. The Part II course will focus on more advanced biological EM sample processing and techniques. It is recommended that students have prior experiences with Biological EM or possess knowledges of the principles and workflow of biological EM sample processing. Students who have taken the Part I course in 2022 are welcome to return. The lectures will cover the topics listed in the bullet points below:

- 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

X-13 Cryo-EM for Materials Sciences: Hardware, Applications and Data Acquisition

LEAD INSTRUCTORS:

Ismail El Baggari, *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.

X-14 Transmission Electron Microscopy and Spectroscopy from First Principles

LEAD INSTRUCTORS:

Toma Susi, *University of Vienna, Austria*

Jacob Madsen, *University of Vienna, Austria*

Paul Zeiger, *Uppsala University, Sweden*

Rebecca Nicholls, *University of Oxford, UK*

Simulations of transmission electron microscopy images and electron energy-loss spectra can not only be vital for correctly interpreting and understanding measured data, but may also be used to design experiments or even instrumentation. With modern open source tools, simulations of all kinds of image signals including HRTEM, ED, DPC and 4D-STEM are easy to learn and tractable on a personal computer. Computational exercises are performed using the open-source Python package abTEM. Simulation of electron energy-loss spectra is more demanding, and requires specialized expertise and high-performance computing resources. Different approaches to model phonon, plasmon and core-loss spectra are introduced.

- (Scanning) transmission electron microscopy image simulations
- Introduction to open-source TEM simulation software
- 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



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Technologists' Forum

X30 - Technologists' Forum Symposia: Methods in Tissue Clearing and Expansion to Achieve Improved Resolution [Partnering with B04]

Speakers:

- Hazel Borges, *UT Southwestern* [Quantitative Cleared Tissue Imaging]
- Alan Watson, *University of Pittsburg* [Considerations for Microscopic Imaging of Whole Organs and Animals]
- Mark Sanders, *University of Minnesota* [Considerations for Tissue Clearing Services in a Shared Research Facility]

ORGANIZERS:

D. Page Baluch, *Arizona State University*

Leon Yongxin (Leon) Zhao, *Carnegie Mellon*

Advances in tissue preparation technologies, such as tissue clearing and expansion microscopy, allows for more effective visualization and understanding of structures and processes in intact biologic systems. This symposium explores the advancements in tissue preparation which push the limits and expand the capabilities of modern light microscopes. This year the Technologists'™ Forum is partnering with the organizers of the Development, Challenges and Biomedical Applications of Tissue Clearing, Super-resolution Microscopy and Tissue Imaging [B04] symposium to provide a series of presentations that will focus on the development of new protocols used in tissue clearing and expansion microscopy.

- 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]

Speakers:

- Andrew Soltisz, *Ohio State University* [Improving Spatial Analysis of Fluorescence Microscopy Images using Point Process Analysis]
- Claudia Lopez, *Oregon Health and Science University* [Novel genetically encoded peptide tags for correlative imaging: lessons learned]
- Christian Wurm [John Waka], *Abberior* [Multichannel Live Cell STED – Dye Combinations and Imaging Techniques for Live Cell Super-resolution Imaging]

ORGANIZERS:

D. Page Baluch, *Arizona State University*

Rengasayee Veeraraghavan, *University of Ohio*

Within the past few years there has been a rapid development of new technologies that have recently transformed the field of optical imaging. These include the various methods in achieving super-resolution microscopy and their applications to living samples, correlative and functional imaging and the development of novel reagents and sample labeling strategies which provide improved visualization of structure and function within biological systems. This year the Technologists' Forum is partnering with organizers of the Innovations in Light Microscopy symposium [B06] to provide a series of presentations that will review the most common protocols used for super-resolution, CLEM, live cell imaging and advances in cell labeling tools.

- 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]

Speakers:

- Tina Bergh, *NTNU* [Scanning Electron Diffraction: To Precess or not to Precess?]
- Yu-Tsun Shao, *USC* [Principles and Applications of 4D-STEM Diffraction Imaging for Characterizing Complex Crystalline Materials]
- Steven Zeltmann, *Cornell* [Choosing Detectors and Analysis Software for 4D-STEM]

ORGANIZERS:

John L. Grazul, *Cornell University*

D. Page Baluch, *Arizona State University*

4D-STEM has advanced the study of materials at a variety of length scales, from the highest-resolution imaging to millimeter-scale mapping of structures and properties. Recent development of novel 4D-STEM techniques further expands our capability to study beam-sensitive samples, and improvement in saturation current and detector speeds allows for in-situ experiments. This symposium covers the latest applications of 4D-STEM in the study of biological and functional materials, developments of new data analysis methods and best practices to further advance quantitative and multiscale characterization. This year the Technologists' Forum is partnering with the organizers of the Praxis 4D-STEM symposium [A04] to provide a series of presentations that will review the most common protocols used in 4D-STEM.

- 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.



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Cross-Topic (Biological & Physical Sciences) Tutorial

X40 – Need for Speed: Imaging Biological Samples with the 64-Beams FAST-EM

Speakers: Jacob Hoogenboom Group, Delft University of Technology, The Netherlands

Large scale and volume electron microscopy (EM) has revolutionized the understanding of biological systems across different spatial scales, but the low throughput of EM limits further progress. In this tutorial, we will illustrate the working principles behind the FAST-EM, a novel multibeam scanning electron microscope with a footprint similar to regular single-beam SEMs. We will present results of faster imaging with FAST-EM and discuss sample preparation, imaging parameters, detection techniques, image post-processing and data analysis.

Physical Sciences Tutorial

X41 – Specimen Preparation for in-situ Transmission Electron Microscopy Experiments

Speaker: Sriram Vijayan, The Ohio State University

Micro electro mechanical system (MEMS)-based in situ heating devices have enabled the observation of thermally activated phenomena under high spatial resolution and low specimen drift inside the transmission electron microscope (TEM). These dynamic

processes provide mechanistic insights on phase transformations, which are critical to understanding process-structure-property relationships in materials. These MEMS based devices are used to study materials systems ranging from nano-particulate samples dispersed across the sample support membrane to thin-foils extracted from site-specific locations in bulk materials via focused ion beam scanning electron microscope. The former is relatively straight forward, however, the latter has proven to be extremely challenging. In this tutorial, a review of different specimen preparation techniques for in situ TEM experiments will be discussed, in addition to, a 'step by step' guide for FIB based specimen preparation for MEMS-based in situ TEM heating experiments. The talk will also cover some important tips and tricks of specimen preparation for a wide array of materials systems and MEMS devices.

X42 - Biological Sciences Tutorial

CryoAPEX: Inception, Growth and Evolution of the Method

Speaker: Ranjan Sengupta, Angiex Inc.

The application of electron tomography in the functional dissection of membrane remodeling within the subcellular space requires localization of candidate proteins in 3D space. The precise localization of membrane proteins at nanometer resolution requires an electron microscopy based robust detection technology coupled with sample preparation that confer superior ultrastructural preservation. Here, I provide step-by step detail of our method, cryoAPEX, which couples chemical fixation and high-pressure freezing of cells with peroxidase tagging (APEX) to allow precise localization of membrane proteins in the context of a well-preserved subcellular membrane architecture. The superior membrane preservation obtained by the cryoAPEX method makes it amenable to electron tomography, arming the versatile APEX tagging technology to answer questions in the realms of organelle biogenesis and in situ membrane remodeling. Question based evolution of the method in its application in virus cell biology will be discussed.

- Understanding APEX2 tagging in the context of the functional preservation of candidate protein
- APEX2 based localization of membrane protein and membrane interacting proteins
- Ultrastructural preservation of cells using hybrid chemical and cryofixation

- Marrying APEX2 tagging with electron tomography: a way to localize proteins in 3D space within the cellular ultrastructure



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Vendor Tutorial Information for Attendees

Exhibitors can hold a Vendor Tutorial in their booth after the exhibit hall closes for the day on Monday, Tuesday and/or Wednesday. This is your opportunity attend a presentation by your favorite Exhibitors.

There is no cost to exhibitors or attendees.

Attendees will sign up for the vendor tutorials directly in the company's booth.

A list of participating companies will be in the MegaBooth and interested attendees will be directed to sign up within the company's booth.

Confirmed Vendor Tutorials

Monday, July 24

Exhibitor	Booth #	Title of Tutorial
3D-Micromac AG	1212	<i>microPREP PRO: New Vistas for Failure Analysis and Sample Preparation</i>
Abberior Instruments America	538	<i>Superresolution, from the Inventors of STED</i>
Clark-MXR, Inc.	1009	<i>Multiple Substrate Micromachining</i>

Electron Microscopy Sciences	1004	<i>The Prepmaster 5100 ensures repeatability and reproducibility. It reliably accomplishes your dull, dangerous, repetitious, and errorprone tasks, increasing confidence in your results and freeing your time for more complex and interesting work</i>
EXpressLO LLC	839	<i>EXLO and its applications for cryo lift out</i>
Gatan/EDAX	504	<i>DigitalMicrograph: A multifaceted platform for advanced STEM studies</i>
Gatan/EDAX	504	<i>Equipment ecosystem for low dose and Cryo-EM</i>
Hitachi High-Tech America, Inc.	1204	<i>Hitachi Powers Your Battery Research and Production</i>
Linkam Scientific Instruments	1420	<i>CryoGenium: new options with the automated robot for plunge-freezing of cryo-samples</i>
Nanoscience Instruments	1112	<i>Phenom Desktop STEM</i>
NenoVision	423	<i>LiteScope - In-Situ Correlative Microscopy</i>
Oxford Instruments	620	<i>Backscattered Electron and X-ray Imaging (BEX)</i>
point electronic GmbH	431	<i>Custom scan patterns with external TEM scan controller (DISS6)</i>
Protochips Inc.	410	<i>Machine vision-based in situ TEM for studying energy materials</i>
SEC Co., Ltd	1304	<i>Raman, CL, EDS and EBIC on a tabletop SEM</i>
TESCAN	819	<i>Accelerating and Advancing Nanoscale Characterization of Materials by seamless 4D-STEM workflows using the new TESCAN TENSOR analytical STEM microscope</i>

Tuesday, July 25

Exhibitor	Booth #	Title of Tutorial
3D-Micromac AG	1212	<i>microPREP PRO: New Vistas for Failure Analysis and Sample Preparation</i>

Abberior Instruments America	538	<i>Superresolution, from the Inventors of STED</i>
Angstrom Scientific Inc	632	<i>Unlocking the Potential of In-Situ Microscopy</i>
Barnett Technical Services	1038	<i>Precise Microsampling with a Benchtop Micromanipulator</i>
Bruker	832	<i>Benchtop XRM</i>
Bruker AXS LLC	832	<i>Full Range Energy Dispersive Spectroscopy (EDS): Revealing higher energy transitions, better lower limits of detection and greater depth of information</i>
CAMECA	404	<i>The Latest APT Technology and Applications from the 2023 APT&M CAMECA Presentations</i>
DECTRIS	1012	<i>4D STEM in practice with DECTRIS ARINA</i>
Direct Electron	1312	<i>Recent Advancements in Direct Detection Cameras</i>
Electron Microscopy Sciences/Quorum	1004	<i>Why there are cracks in my coating? How to avoid mistakes in sample preparation for Electron Microscopy Imaging.</i>
Gatan/EDAX	504	<i>How to use spherical indexing in OIM Analysis for better data quality</i>
Gatan/EDAX	504	<i>Multimodal in-situ spectroscopy</i>
Hitachi High-Tech America, Inc.	1204	<i>Automated Materials Analysis for Electronics and Battery Recycling</i>
JEOL USA	706	<i>A new FIB/SEM for TEM Sample Preparation Workflow</i>
Linkam Scientific Instruments	1420	<i>CryoGenium: new options with the automated robot for plunge-freezing of cryo-samples</i>
Nanoscience Instruments	1112	<i>VitroJet: Fully automated controlled cryo-EM sample preparation</i>
Nion Company	1104	<i>Latest Developments with Nion Microscopes</i>
Prior Scientific	T-1504	<i>Innovation in Nanopositioning</i>
Protochips Inc.	410	<i>Unlocking the Full Potential of Your Data with a Research Data Management Machine-Vision Platform – DN</i>

Quantum Detectors	1031	<i>Quantum Detectors showcase 4D STEM with MerlinEM</i>
Ted Pella, Inc	904	<i>Tissue Clearing & decalcification using the PELCO BioWave</i>
TMC	404	<i>Introducing STACIS 4 Active Piezoelectric Vibration Control with Patented FloorSense™ Technology</i>

Wednesday, July 26

Exhibitor	Booth #	Title of Tutorial
3D-Micromac AG	1212	<i>microPREP PRO: New Vistas for Failure Analysis and Sample Preparation</i>
Abberior Instruments America	538	<i>Superresolution, from the Inventors of STED</i>
Attocube systems Inc	1137	<i>Nanoscale optical analysis methods: AFM-IR, s-SNOM, nano-FTIR</i>
Barnett Technical Services	1038	<i>Microplastics Sampling and Detection</i>
DECTRIS	1012	<i>4D STEM in practice with DECTRIS ARINA</i>
Delmic B.V.	1110	<i>Live demonstration of METEOR: Delmic's integrated cryo-FLM system</i>
Gatan/EDAX	504	<i>From electrons to images: A crash course in EM camera technology</i>
Hitachi High-Tech America, Inc.	1204	<i>Optimization of Cryo-TEM Screening Utilizing Hitachi's 120 kV HT7800 TEM</i>
Hummingbird Scientific	932	<i>Recent advances in in-situ microscopy: multi-model and multi-stimuli in-situ microscopy</i>
JEOL USA	706	<i>Special guest speaker – Advanced Developments for TEM</i>
Linkam Scientific Instruments	1420	<i>CryoGenium: new options with the automated robot for plunge-freezing of cryo-samples</i>
Nanoscience Instruments	1112	<i>Graphene liquid cells and their newest applications in TEM</i>

NenoVision	423	<i>LiteScope - In-Situ Correlative Microscopy</i>
Nion Company	1104	<i>Nion Swift - A tool for Data Acquisition, Analysis, and Advanced Microscopy</i>
point electronic GmbH	431	<i>Novel electrode-based BSE detector for in-situ microscopy</i>
Quantifoil and SPT Labtech	1138	<i>An Introduction to HexAuFoil next-generation cryoEM grids</i>
SiriusXT	532	<i>Biological Soft X-ray Tomography</i>
TESCAN	819	<i>Streamlining Materials Science Sample Characterization with Highly Automated FIB-SEM TEM Sample Preparation for analysis in TESCAN TENSOR 4D-STEM</i>



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MEETING AWARDS

How to Apply For M&M Meeting Awards:

Apply for M&M meeting awards during the online paper submission process. An applicant must check a box 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 (up to one in each of three categories).

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 for 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

(https://www.microscopy.org/awards/micrograph_competition.cfm)

Scientifically significant micrographs:

Published category (images published in 2021)

Open category (unpublished images)

Video category (movies and 3-D reconstructions)

Submission site to open December 2023

Deadline for submission is February 16, 2023

Prizes awarded at M&M 2023 in Minneapolis, MN



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