(/MandM/2022/)

Microscopy and Microanalysis (M&M) Meeting Updates

Join us in Portland, Oregon, July 31-August 4!

Don't miss out on the premier microscopy education and networking event of the year - Microscopy & Microanalysis 2022 in Portland, Oregon, July 31-August 4!

Portland provides an ideal summer backdrop for what promises to be another stellar M&M meeting! The Pacific Northwest region is a vacationer's dream, with numerous activities for outdoor enthusiasts and urban adventurers alike. Tax-free shopping; countless local breweries, distilleries, and wineries; legendary Portland food carts and hundreds of restaurants with cuisine from all over the world; unparalleled hiking, camping, boating and sightseeing in the Cascade and Olympic National Parks, the picturesque Oregon Coast, and the stunning Columbia River Gorge.

Don't miss out! Save the Date and plan to attend Microscopy & Microanalysis 2022 with over 1200 platform and poster sessions, workshops, tutorials, and networking events, in addition to four days of the world's largest Microscopy products and services commercial expo hall in the world.

Health Safety Update as of June 1, 2022

MSA & MAS continue to monitor official Centers for Disease Control COVID-19 safety protocols working closely with our partners at the Oregon Convention Center, the city of Portland and Multnomah County, and the state of Oregon. Guidelines are changing constantly across the United States and we are working to create the safest environment

possible for this event. Participant well-being is our first priority. Here's what we're doing to protect your health and peace of mind so you can focus on getting the most from this event.

- **Proof of Vaccination:** Your proof of vaccination must include the type of vaccination provided and the dates of doses was administered. A digital copy stored on a phone or electronic device, or a printed photo of a vaccination card are acceptable in addition to the original card or record.
- **Masks Required:** Masks are required indoors in the Oregon Convention Center, in alignment M&M 2022 attendance guidelines. M&M attendees will be required to wear masks as follows:
    - **Speakers will be permitted to remove their masks when actively giving their presentations, if they wish.**
    - Attendees will be permitted to remove their masks briefly while actively eating or drinking at official M&M 2022 functions.

Before You Leave Home

M&M encourages all registrants, exhibitors, staff and service partners to:

- Carry proper proof of vaccination documentation with you at all times.
- Get your COVID-19 booster shot.
- Stay home if you are feeling sick.
- Test for COVID-19 before leaving for the event.

Access to Live Conference and Exhibition

M&M will adhere to venue meeting procedures and guidelines and will follow strict **CDC guidance for meetings and events (https://www.cdc.gov/coronavirus/2019-ncov/your-health/gatherings.html)** while allowing guests to come together safely.

M&M will require proof of full vaccination to enter this event. There are no exceptions. Any individual attending the M&M 2022 in-person events including: registered attendees, guests, exhibitors and M&M staff, OCC staff, and service partners must be **fully vaccinated (https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinated.html)** in order to gain access to this event.

- **Proof of Vaccination:** Your proof of vaccination must include the type of vaccination provided and the date that the last dose was administered. A digital photo of a CDC-issued vaccination card stored on a phone or electronic device, or a printed photo of

a CDC-issued vaccination card are acceptable in addition to the original card or record.

- **Defining Fully Vaccinated (https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinated.html):** A person is considered fully vaccinated 14-days after their final dose of a two-dose vaccine series, such as the Pfizer and Moderna vaccines or any **World Health Organization approved vaccine (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines)**.

  World Health Organization-approved vaccine for international participants listed below.

  - Moderna
  - Johnson & Johnson / Janssen
  - Pfizer/BioNTech
  - Oxford/AstraZeneca
  - Sinopharm
  - Covovax
  - Novavax
  - CoronaVac
  - Covaxin
  - Covishield

No Vaccine Exemptions:
If an attendee, exhibitor, or M&M staff member does not meet the vaccine requirements outlined on this page, they are **NOT** considered fully vaccinated and will not be permitted to attend M&M 2022 in-person.

Masking Requirements

M&M will continue to monitor local, state and CDC guidelines. At this time, masks will be required while in the official event space. **A tight-fitting mask is recommended.**

Masks are required indoors in the by the Oregon Convention Center, in alignment with the City of Portland guidelines. M&M attendees will be required to wear masks as follows:

- On the exhibition floor, including in booths and during set-up and dismantle.
- In conference sessions and short courses.
- At networking events â€“ even those that include food and drink.

Note that those individuals presenting at this event, may remove their mask during their scheduled presentation.

CDC, State and Local Guidelines

All participants are expected to follow local and facility guidelines as well as travel safety guidelines when using ground and air transportation enroute to the event.

- **Centers for Disease Control and Prevention (https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fvaccines%2Ffully-vaccinated-guidance.html)**
- **State of Oregon (https://coronavirus.oregon.gov/Pages/default.aspx)**
- **City of Portland (https://www.travelportland.com/plan/coronavirus-faq/)**
- **Oregon Convention Center (https://www.oregoncc.org/en/venue-2020-coronavirus-covid-19-faq)**

Travel Guidelines

M&M recommends all attendees, exhibitors and MSA & MAS staff comply with **travel guidelines (https://www.cdc.gov/coronavirus/2019-ncov/travelers/index.html)** issued by the CDC when traveling to Portland, OR USA. In addition, all individuals should think carefully about any risk they may pose to others and make informed choices about travel as well as onsite and external engagement.

Patience, Please

As has been the case this past 18 months, the situation is changing constantly, and guidelines are fluid. **M&M reserves the right to change these guidelines at any time and to deny entry to this event to any participant not in compliance with these guidelines.** Please be patient with event organizers, facility partners, and your fellow event participants, and please operate with kindness and understanding.

M&M will continue to evaluate what is best for event participants to ensure we meet safely and that every attendee and member of the staff and service communities are comfortable.

Additional questions can be directed to M&M Meetings Director (mailto:meetingmanager@microscopy.org).

Registration for On-Demand Access is NOW OPEN

REGISTER NOW (https://www.eventscribe.net/2022/MandM/)

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(https://www.microscopy.org/)

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Email: **Association Management (mailto:AssociationManagement@microscopy.org)** – **Terms of Use (/terms.cfm)**

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For Authors & Presenters

M&M 2022 Call for Papers is NOW OPEN!

Submit Your Paper! (https://www.abstractscorecard.com/cfp/submit/login.asp?EventKey=DHSGHMEY)

- **Manuscript Preparation & Information (https://www.microscopy.org/MandM/2022/program/Manuscript_Preparation_Guidelines-2022.pdf)** (.pdf)
- **Paper Template (https://www.microscopy.org/MandM/2022/program/MMPaperTemplate2022.doc)** (.doc/.docx)

Please whitelist or mark this email (**mmspeakers@conferencemanagers.com (mailto:mmspeakers@conferencemanagers.com)**) 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 2022.

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 2022 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.

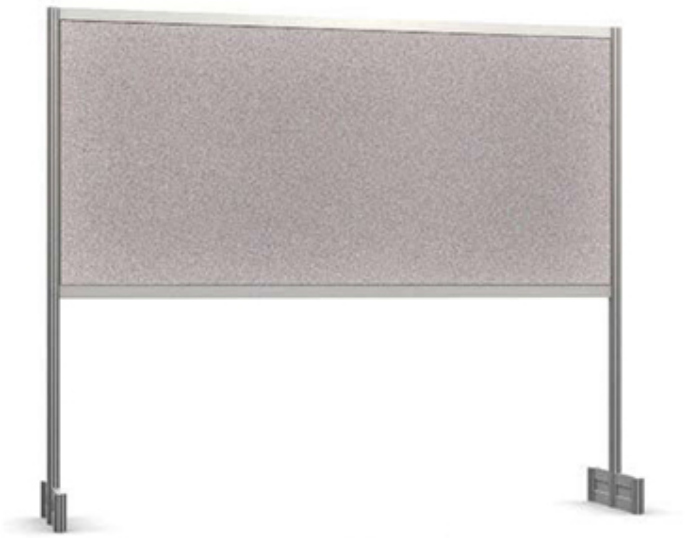
4. If you don't have a computer to bring, ask your symposium organizer or session chair if you can use another presenter's machine.
5. If you bring a computer, please make sure that you have administrative access and know the password.
6. If possible, we suggest bringing your presentation on a flash 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; however, all posters are required to be displayed for the duration of the meeting.

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 male 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.

(https://www.microscopy.org/)

(http://www.microbeamanalysis.org/)

(http://www.msc-smc.org/)

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Full Symposium Descriptions

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

Analytical Sciences Symposia

A01 - Advances in Focused Ion Beam Instrumentation, Applications and Techniques in Materials and Life Sciences

ORGANIZERS:

Suzy Vitale, *Carnegie Institution for Science*

Frances Allen, *University of California, Berkeley*

Joshua Sugar, *Sandia National Laboratories*

Matthew Thorseth, *Dow*

The objective of this symposium is to provide an overview of recent developments in focused ion beam instrumentation, as well as a platform for FIB users to share and discuss novel applications and techniques across multiple scientific disciplines. Our focus will be on innovative approaches to imaging, sample preparation, micro/nanofabrication, and analytics that go beyond conventional methods in materials and life sciences, and the research that drives these new applications.

- Latest developments in novel ion sources, FIB instrumentation, and software
- Advances in helium ion microscopy including automation, SIMS, nanofabrication, lithography and imaging with charge neutralization

- Novel geometries, milling strategies and non-standard lift outs for TEM/STEM, APT, and other techniques
- Enhancing analytical SEM with FIB, including 3D EDS/EBSD and other correlative analytics including WDS, CL, Raman spectroscopy, EBIC, TKD, u-CT
- Advances in cryo-FIB, cryo sample transfer techniques, and working with beam-sensitive materials
- Innovative micro and nano-structure prototyping.

A02 - Beyond Visualization with in situ and Operando TEM

ORGANIZERS:

Taylor Woehl, *University of Maryland*

Yuanyuan Zhu, *University of Connecticut*

Chongmin Wang, *Pacific Northwest National Laboratories*

As in situ liquid and gas TEM imaging techniques become more mature, researchers are beginning to consider how to push their boundaries for quantitative understanding of material dynamics and transformations. As in situ TEM data becomes increasingly multidimensional (in real and reciprocal space) and synchronous (in situ images with real-time readout of temperature, pressure/flow, product signal, etc.), there is significant interest in extracting and even real-time tracking of quantitative information from these exceptionally rich data sets. This symposium invites papers from across the sub-fields of in situ TEM, including applications such as electrochemical systems, catalysis, 2D materials, and soft materials, focused on identifying, extracting, and measuring dynamic structural descriptors and their outcomes to advance our understanding of materials dynamics. Papers utilizing scalable computer algorithms including conventional image analysis and machine learning to extract descriptors and perform quantitative and correlative analysis (e.g. size measurement, particle tracking) on in situ TEM data sets are especially encouraged. Particular focus will be put on rigorously establishing that in situ environmental conditions lead to kinetics that are similar to the corresponding real world processes the materials are involved in.

- Redox reactions and restructuring of nanoparticles in gases and liquids
- Computer-assisted quantitative information extraction
- Machine learning for feature recognition and tracking in in situ TEM video data
- Synchronization and integration of simultaneously acquired in situ data
- Establishing 'real world' relevant conditions during in situ TEM
- Multimodal and postmortem characterization of materials formed during in situ TEM.

A03 - Advanced 3D Imaging and Analysis Methods for New Opportunities in Materials Science

ORGANIZERS:

Roland Brunner, *Materials Center Leoben*

Julie Villanova, *European Synchrotron Radiation Facility*

Guillermo Requena, *Das Deutsche Zentrum für Luft- und Raumfahrt*

Steve Kelly, *Zeiss Group*

We invite contributions from researchers developing and applying 3D imaging methods to drive material science. The scope of the symposium is to incorporate: (1) advanced 3D image analysis methods (conventional as well as machine-learning-based), (2) a variety of microscopy approaches based on synchrotron, FIB-SEM, neutron-tomography, XCT and X-ray microscopy, (3) the combination of morphology with structural and chemical information including multi-method/scale/in situ workflows as well as (4) the combination with computational modelling methods e.g., FEM, CFD, etc. Examples of relevant classes of materials include, but are not limited to, energy materials, lightweight materials, new structural alloys, and composites.

- 3D morphology/structure/chemical analysis, including in situ microscopy methods for material science
- Challenges with respect to image analysis
- Challenges with respect to correlative studies including multi-method/scale/in situ workflows
- Challenges with respect to the use of image data for computational modelling methods (e.g. RVE).

A04 - Developments of 4D-STEM Imaging - Enabling New Materials Applications

ORGANIZERS:

Laura Clark, *University of Oxford*

Michele Conroy, *University of Limerick*

Colin Ophus, *Lawrence Berkeley National Laboratory*

David Muller, *Cornell University*

4D-STEM is rapidly advancing, pushing the boundaries of which beam-sensitive materials and what functional-material processes can be studied in the microscope. Phase contrast imaging using ptychography and other advanced methods are increasing resolution far

beyond conventional limits, and DPC methods are revealing the electromagnetic structures of specimens more clearly than ever before. It is also now possible to measure structure properties such as strain, orientation, order, and disorder from millions of sample points, providing statistically robust measurements over functional length scales. This symposium covers the latest developments of these techniques and applications of these methods to visualize novel materials phenomena.

- Increased access to 4D-STEM detectors is leading to a proliferation of 4D-STEM imaging techniques
- Electron ptychography is particularly powerful for low-dose and for super high-resolution imaging and is a rapidly developing field (both iterative and direct techniques)
- This symposium seeks submissions showing new technique developments applied to enable new materials insights.

A05 - Quantitative and Qualitative Mapping of Materials

ORGANIZERS:

Emma Bullock, *Carnegie Institution for Science*

Angela Halfpenny, *Central Washington University*

This symposium will discuss applications and advances in qualitative and quantitative mapping utilizing techniques such as energy-dispersive spectrometry, wavelength-dispersive spectrometry, x-ray fluorescence, electron backscatter diffraction, secondary ionization mass spectrometry, cathodoluminescence and laser ablation mass spectrometry. The software used to produce and manipulate maps will be discussed, as will best-practice methods for obtaining optimum results. Applications include, but are not limited to, geological and extraterrestrial materials, semiconductors, biological materials, and ceramics.

- Quantitative element mapping
- Qualitative mapping
- EDS/WDS/EBSD/XRF/SIMS/LA-ICPMS/CL
- Geological and extraterrestrial materials
- Biological materials
- Metals, ceramics and semiconductors.

A06 - Expanding the Limits of Atom Probe Tomography

ORGANIZERS:

David Diercks, *Colorado School of Mines*

Jonathan D Poplawsky, *Oak Ridge National Laboratory*

Francois Vurpillot, *Universite' De Rouen*

Ann Chiaramonti Debay, *National Institute of Standards and Technology*

The use and development of atom probe tomography has been rapidly expanding and improving in many areas including hardware capabilities, reconstruction algorithms, data mining and processing, and new material applications. This symposium will present efforts exploring frontiers in atom probe tomography and field ion microscopy.

- New hardware developments, such as detector and laser technology, in-situ experimental designs, and APT integration with other techniques.
- Novel applications or the technique such as cryo-transfer, in-situ experiments, and cutting edge materials.
- Studies aimed at improving reconstructions, including field evaporation simulations, reconstruction algorithms, and mass spectra analysis.
- A focus on extracting more from atom probe data. Specifically, software tools for improved assessment and visualization of key and non-obvious features within the data including statistical methods, data mining, and machine learning are of interest.

A07 - Science of Metrology with Electrons

ORGANIZERS:

Andrew Barnum, *Thermo Fisher Scientific*

Sujitra Pookpanratana, *National Institute of Standards and Technology*

With increasing integration of nanotechnologies into products and processes across engineering and manufacturing disciplines, new techniques are required to tackle the challenges of process monitoring and critical dimension analysis. With the capability of electron microscopy to provide imaging across a variety of signal modalities and resolutions to atomic lattice dimensions, electron microscopy has become a critical linchpin for metrology across industries. The growing volume of data provided by automated acquisition and increasing reliance on these techniques to solve a variety of metrology problems underscores new requirements for routine calibrations across analytical modes for properties such as length, strain, chemical composition, and optical

behavior, as well as electric and magnetic fields. This symposium will feature current state-of-the-art, recent progress, and new challenges in the field of calibration and metrology for electron microscopes.

- Methods of calibration to ensure bounded accuracy of quantitative measurements for properties such as length, strain, chemical composition, and optical behavior, as well as electric and magnetic fields.
- Creation and use of reference metrologies for calibration transfer between systems.
- Traceability across multiple systems and types of measurements, with a focus on applications in TEM.

A08 - From Operando Microcell Experiments to Bulk Devices

ORGANIZERS:

Vasiliki Tileli, *Swiss Federal Institute of Technology Lausanne*
William C. Chueh, *Stanford University*
Martial Duchamp, *Nanyang Technological University*

Performing operando experiments using liquid, gas, electrochemical, or heating and biasing stimuli provides valuable insights that can aid the development of next-generation technologies. However, microdevices used to perform operando studies suffer from major limitations that make the acquired results inconsistent with their bulk counterparts. Scanning or transmission electron and x-ray microscopy/spectroscopy techniques all exhibit limitations having to do with the setup and its operation, beam-induced irradiation effects, and temporal, spatial, or energy resolution. This symposium aims to assess the consistency of operando experiments with process that take place in real-life devices including batteries, fuel cells, memory devices, etc.

- Optimizing operando experiments in liquid, gas, or high vacuum conditions to make them relevant to bulk device measurements.
- Bridging the length scales in operando experiments (from meso to micro to nanoscale imaging).
- Strategies to mitigate electron or x-ray artifacts under realistic conditions in operando experiments.
- Development of novel methodologies for the preparation of microdevices for operando experiments.

A09 - Ultrashort Pulse Lasers: Microscopy, Simulations, and Material Interactions

ORGANIZERS:

Steven Randolph, *Thermo Fisher Scientific*

Andrew Polonsky, *Sandia National Laboratories*

McLean Echlin, *University of California Santa Barbara*

Remco Geurts, *Thermo Fisher Scientific*

Ultrashort pulsed lasers continue to gain adoption in the microscopy and microanalytical community due to unique attributes of fast material removal rates, the extremely low-damage ablation process, and the ability to process a wide range of materials. The combination of ultrashort pulsed lasers with SEM/FIB greatly expands the 2D and 3D capability of these instruments, including 3D materials science, fundamental laser-material interaction experiments, and ultrafast photochemistry. This symposium calls for novel results and simulations enabled by ultrashort pulsed lasers or laser-material interactions. Submissions in the fields of materials science, energy storage, biology, electronic materials, microelectronics, and laser-material interactions are welcomed.

- Development of workflows and techniques combining ultrashort pulsed lasers / SEM / FIB processing to perform 2D and 3D microanalysis that is uniquely enabled by laser technology
- Materials, electronics, biology, and energy storage application spaces addressed with ultrashort pulsed lasers
- Material response to and physics of ultrashort pulsed lasers, including damage mechanisms
- Modeling of the response of laser-material interactions and of the ablation process.

A10 - Surface and Subsurface Microscopy and Microanalysis of Physical and Biological Specimens

ORGANIZERS:

Vincent Smentkowski, *GE Research*

John A Chaney, *The Aerospace Corporation*

Xiao-Ying Yu, *Pacific Northwest National Laboratory*

Ryan Wagner, *Purdue University*

Surface properties dictate the performance of many physical and biological systems. The surface analyst is asked to detect and image species present in ever-lower concentrations and within ever-smaller spatial and depth dimensions. This symposium emphasizes state-of-the-art surface analytical instrumentation encompassing all aspects of surface and near-surface analyses, such as 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); the use of complementary surface instrumentation to perform a complete analysis of complex systems; quantitative microanalysis; data processing; and surface analytical challenges. Both platform and poster presentations are encouraged.

- State of the art surface analysis and instrumentation
- Advances in scanning probe microscopy for quantitative analysis including nano-scale chemical, mechanical & electrical analyses, for example, TERS, IR, nanomechanical modes.
- How novel surface methods expand and compliment traditional SEM/TEM.
- Correlative microscopy /multidimentional microscopy - combing multiple analytical technologies.
- Data processing in microscopy: Hyper-spectral data, 3D imaging, multivariate statistical analysis, and machine learning.

Biological Sciences Symposia

B01 - Microcrystal Electron Diffraction (MicroED)

ORGANIZERS:

Brent Nannenga, *Arizona State University*

Tamir Gonen, *University of California LA*

Microcrystal electron diffraction, or MicroED, is a method that can determine high-resolution structures from very small and thin 3D crystals. MicroED has been applied to a variety of microcrystalline samples, including those of biological molecules, small organic molecules, and samples from materials science. This session will focus on recent applications of MicroED for structure determination, as well as advances in MicroED methodology.

- MicroED is capable of using microcrystals for high-resolution structure determination
- Can be applied towards a variety of samples, from biological to inorganic materials
- Session will focus on applications and advanced methods development.

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

ORGANIZERS:

Teresa Ruiz, *University of Vermont*

Melanie Ohi, *University of Michigan*

Cheri Hampton, *AFRL/RXAS Wright-Patterson Air Force Base*

William Rice, *NYU Langone Health*

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.

- Structure and function of macromolecular complexes in vitro and in vivo
- Single particle cryo-electron microscopy
- Cryo-electron tomography
- Molecular modeling

B03 - Technical Advances in Cryo-EM

ORGANIZERS:

Mike Marko, *State University of New York, Wadsworth Center*

Christopher Russo, *University of Cambridge*

Anchi Cheng, *New York Structural Biology Center*

Cryo-EM technology is in the tradition of advances in biological TEM that has long been a part of (E)MSA. These include advances in the TEM itself, as well as in cameras, specimen preparation, stages, and software. Results are now competitive with x-ray crystallography, and resolution in, single-particle cryo-EM is now in the atomic range, previously obtained only in materials science. Advances in cryo-EM are coming quickly, considerably widening the popularity of the technique. Speakers representing many of the current advances will be invited, and all contributions related to this topic will be most welcome.

- Application of low-dose STEM methods
- Methods for combating beam-induced motion

- Potential for TEM development to widen applications
- Advances and considerations for optimal specimen preparation
- Advances in image-processing for cryo-EM and cryo-ET
- Appropriate application of Micro-ED.

B04 - Correlative and Multimodal Microscopy and Analysis

ORGANIZERS:

Si Chen, *Argonne National Laboratory*
Xiao-Ying Yu, *Pacific Northwest National Laboratory*
James Fitzpatrick, *Washington University, St. Louis*
Jacob Hoogenboom, *TuDelft*

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.

- Correlative microscopy instrumentation and workflows
- Cryogenic sample preparation and handling
- In-situ sample environment
- Multi-modal data analysis pipeline

B05 - Challenges and Advances in Electron Microscopy Research and Diagnosis of Diseases in Humans, Plants and Animals

ORGANIZERS:

Claudia Lopez, *Oregon Health & Science University*
Marcela Redigolo, *West Virginia University*
Joe Mowery, *USDA Agriculture Research Service*

This symposium covers diverse content related to the research and diagnosis of diseases in humans, animals and plants. The application of various microscopy techniques providing in-depth investigations of disease mechanisms exhibits the versatility of these techniques as key-tools in diagnosis and in the understanding of the host, the host-

pathogen interaction, and its environment. Some of these methods allow for a rapid detection and identification of novel agents, including those not considered by the investigator or clinician, making these techniques highly important in clinically or epidemiologically critical situations. Target attendees include scientists from all levels of bio-imaging expertise and related backgrounds.

- Enhancement of sample preparation workflow for EM analysis of complex tissue for diagnosis or research
- Application of advanced or innovative EM techniques to study host-pathogen interactions, virulence factors and ultrastructural changes
- Electron microscopy in a diagnostic network: recruitment of instruments and microscopists around the world during critical situations and outbreak management, such as a pandemic
- Electron Microscopy for Rapid Diagnosis of Emerging Infectious Agents
- Laboratory safety, considerations and sample preparation methods for microscopy analysis of biohazardous specimens
- Three-dimensional electron microscopy techniques for diagnosis and advanced culture methods and the use of organoids, microspheres and bioprints as models.

B06 - Imaging, Microscopy, and Micro/Nano-Analysis of Pharmaceutical, Biopharmaceutical, and Medical Health Products — Research, Development, Analysis, Regulation, and Commercialization

ORGANIZER:

Daniel Skomski, *Merck & Co. Inc.*

This symposium, sponsored by the Pharmaceuticals Focused Interest Group (FIG), will present diverse content related to the research, development, manufacture, and use of pharmaceuticals, medical products, and devices. The intent is to connect subject matter experts dealing with the application of microscopy, imaging, and micro/nano-analysis towards problems of interest to the pharmaceutical, biopharmaceutical, medical, device, and health fields. In-depth technical presentations will address the unique problems that arise during drug discovery and development, method development and optimization, vaccine research, formulation, biocompatibility, production, product life cycle management, and eventual patient use. Addressed topics in the research include material design and properties, physiochemical characterization (actives, excipients, contaminants, small molecule/large molecule/intermediate, polymorphs, particles), product performance, pharmacology, manufacturing, failure modes, biocompatibility, stability, shelf-life, sterility,

etc. Also of interest is an understanding of regulations and data integrity concerns as applied to the pharmaceutical industry. Vendors and service providers are encouraged to submit abstracts which describe the use of their technologies as they apply to pharmaceutical industry problems.

- Root cause analysis of issues related to the manufacturing of drugs, medical products, and devices in both R&D and good manufacturing practice (GMP) settings
- Utilization of techniques and methods to overcome unique product performance and pharmacology challenges (polymorphs, contaminants, particles, etc.)
- Regulatory and data integrity compliance of instrumentation and methods in the pharmaceutical industry
- Investigations and evaluations of testing and drug and vaccine development throughout a product lifecycle (identification, development, testing, supply chain, regulatory, etc.)
- Device and throughput challenges (failure mode analysis, biocompatibility, sterility, etc.).

B07 - 3D Volume Electron Microscopy in Biology Research

ORGANIZERS:

Alice Liang, *NYU Grossman School of Medicine*
Christopher Guerin, *Flanders Institute of Biotechnology (Emeritus)*
Ru-ching Hsia, *Carnegie Institution for Science*

Electron microscopy remains the gold standard for examining the ultrastructural details of cells and tissues. However, for many years obtaining EM data in three dimensions was a difficult and labor-intensive task. Over the last 20 years several approaches, and technologies have been developed that make 3D EM analysis of complex tissue or whole cells increasingly efficient and accessible. While automation of the acquisition, and partial automation of the data reconstruction steps has been achieved, the path to vEM is still challenging at the sample preparation stage. This symposium will evaluate several methods jointly termed Volume electron microscopy (vEM): serial block face scanning electron microscopy (SBF-SEM), focused ion beam scanning electron microscopy (FIB-SEM) and array tomography (AT). Discussions will include different options for vEM, the challenges and improvement of sample preparation protocols and the potentials of the 3D information to answer questions not adequately addressed with 2D techniques.

- Challenges and advancement in sample preparation for volume EM

- Innovation in combined volume EM and Correlative Light and Electron Microscopy (CLEM) workflow
- Application of volume EM techniques in biomedical research
- Techniques, instrumentation, and software development for volume EM image acquisition and analysis.

B08 - From Images to Insights: Working with Large Multi-modal Data in Cell Biological Imaging

ORGANIZERS:

Kedar Narayan, *Frederick National Laboratory, National Cancer Institute*
Camenzind G Robinson, *St Jude Children's Research Hospital*
Aubrey Weigel, *HHMI, Janelia Research Campus*

Biological imaging is producing ever larger data sets but is also quickly becoming multi-modal with disparate imaging technologies often being utilized, yet the ability to handle and analyze these data often lags far behind, especially in smaller labs and core facilities. Appropriate integration and correlation of disparate data streams at various scales, and portability of automated solutions remain daunting. This symposium aims to address issues and solutions stemming from large and multi-modal image data in cell biology, including image processing, correlation, segmentation, visualization, and analysis, especially in the context of open-source options.

- Processing, storing, and distributing large image data in cell biology
- Correlating images and metadata from LM, EM, other modalities (XRM, chemical imaging, etc)
- Identifying, segmenting, and visualizing features of interest efficiently
- Adapting and applying open-source tools and frameworks for image processing and analysis
- Implementation of scalable solutions for small and mid-sized labs and facilities.

B09 - Memorial Symposium: Shinya Inoue

ORGANIZERS:

David Piston, *Washington University in St Louis*
Wendy Salmon, *University of North Carolina*

Shinya Inoue was a pioneer in live cell imaging, who made seminal discoveries in cell division, fertilization, and early embryonic development. In the pursuit of cell biological mechanisms, he made repeated improvements to his microscopes, and incorporated the best developments from others. To reach beyond his own research, he founded an annual microscopy course at Woods Hole that fostered interactions between the microscopy industry and the research community. This symposium will honor the future of Dr. Inoue's vision, where symbiotic improvements in microscopy techniques and understanding of biological mechanisms continue to enable new discoveries.

B10 - Development, Challenges and Biomedical Applications of Tissue Clearing, Expansion Microscopy and Volumetric Imaging

ORGANIZERS:

Yongxin (Leon) Zhao, *Carnegie Mellon University*

Alan M. Watson, *University of Pittsburgh*

The capability of modern light microscopes to study biologic processes 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 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.

Physical Sciences Symposia

P01 - Emerging Methods for Characterizing Hydrogen Effects in Metals and Alloys

ORGANIZERS:

Yi-Sheng (Eason) Chen, *University of Sydney*

Arun Devaraj, *Pacific Northwest National Laboratory*

May Martin, *National Institute of Standards and Technology*

Motomichi Koyama, *Institute for Materials Research, Tohoku University*

The presence of hydrogen in metals can lead to catastrophic failures known as hydrogen embrittlement. A solution for this problem requires a multiscale understanding of microstructural hydrogen behaviors for which atom probe tomography, nanoscale secondary mass ion spectroscopy, neutron tomography and other methods have proven to be powerful. Combined with structural information provided by both in-situ and ex-situ electron microscopy, these techniques have improved the understanding of how hydrogen causes hydrogen embrittlement and how to prevent it. This symposium aims to bring together worldwide researchers focused on such emerging methods for characterizing hydrogen effects in metals and alloys.

- Design against hydrogen embrittlement requires fundamental understanding available only through advanced characterization techniques
- Progress of hydrogen characterization by atom probe tomography (APT)
- New development in hydrogen characterization by nanoscale secondary ion mass spectroscopy (NanoSIMS)
- Hydrogen characterization by neutron tomography
- Progress of characterizing hydrogen effect in micro and nanoscale by in-situ and ex-situ microscopic techniques.

P02 - Quantum Materials Under Electron Beam: From Atomic Structures to Working Devices

ORGANIZERS:

Wenpei Gao, *North Carolina State University*

Kai He, *Clemson University*

Jiong Zhang, *Intel Corporation*

Existing imaging techniques in electron microscopy, including holography, ptychography, differential phase contrast, electron energy loss spectroscopy and their in-situ experimentation, now offer better spatial, temporal and energy resolution, thanks to the advancement in instrumentation and imaging theory. This extends our capability to study the structure, phonon, spin and other exotic states of quantum materials, including two-dimensional materials, topological insulator, and other candidate materials for quantum information sciences. This symposium will focus on recent progress in electron microscopy study of quantum materials, from the development of characterization theory and techniques in materials imaging, to applications through in-situ studies on conceptual devices.

- New development in imaging methods, instruments, and big data analytics to access quantum functionality
- Probing electronic structures and magnetic states in 2D materials and complex oxides using ptychography and 4D STEM
- Characterizing phonons and vibrational properties in semiconductor and electronic materials
- Imaging topological materials
- In-situ microscopy and spectroscopy of electronic materials under biasing.

P03 - Imaging Chemical Reactions using High Speed Electron Microscopy (EM)

ORGANIZERS:

Elena Besley, *University of Nottingham*

Angus Kirkland, *University of Oxford*

This symposium highlights recent breakthroughs in advanced materials processing, high-speed EM imaging, image analysis or big data and computational modelling used as an analytical tool for quantitative analysis of chemical kinetics at the nanoscale. High-speed EM can be usefully harnessed as a controlled source of energy to promote chemical reactions, controlling their rates, and activating additional reaction channels. High-speed EM allows the direct observation of key intermediate states in chemical reactions. These advances contribute to further chemical understanding of the dynamics of electron beam induced processes typically delivered by computational modelling.

- Millisecond time resolved imaging experiments applied to a wide range of nanoscale materials
- Automated pattern recognition and machine learning techniques for automatic detection of reaction products and intermediates, enabling analysis of large datasets spanning extended timescales
- Development and characterisation of nanoscale devices based on fast structural changes
- Advances in computational modelling suitable for analysis of chemical reactions in EM.

P04 - Mechanisms of High Strain Rate Plastic Deformation: Plasticity and Microstructural Evolutions of Adiabatic Shear Bands

ORGANIZERS:

Francis Tetteh, *York University*

Solomon Boakye-Yiadom, *York University*

Ali Eliasu, *York University*

Kenneth Hukpati, *York University*

Under high strain rates such as car crash, ballistic impact, etc., structural materials (metals) become exposed to increasingly extreme conditions in applied pressures, strain-rates, strains and temperatures and are easily susceptible to strain localization, which results in the formation of Adiabatic Shear Bands. Also, the mechanical behavior of materials at high strain rate is however, different compared with quasi-static strain rates. It is characterized that the initiation of strain localization and formation of shear bands are manifestations of damage in metallic materials subjected to large strains of deformation and may lead to final catastrophic failure.

This session would discuss the foundation and knowledge acquisitions in plasticity and microstructure evolutions that characterize the deformation behaviors of structural materials at high strain rate dynamic loadings.

- Foundation and knowledge acquisition in plasticity
- Mechanisms of strain localizations and microstructural evolution of adiabatic shear bands
- High strain rate dynamic deformations.

P05 - In Situ TEM Characterization of Dynamic Processes during Materials Synthesis and Processing

ORGANIZERS:

Dongsheng Li, *Pacific Northwest National Laboratory*

Qian Chen, *University of Illinois*

Yu Han, *King Abdullah University of Science and Technology*

Barnaby Levin, *Direct Electron*

In situ transmission electron microscopy (TEM) techniques have emerged as primary tools for characterizing the dynamics of materials formation. The development of in situ TEM capabilities has led to rapid advances in our understanding of a range of dynamic processes, including nucleation, growth, and assembly in colloidal, electrochemical, organic, semiconductor, and other systems. The symposium covers a broad range of topics including particle nucleation, crystal growth, phase transformations, polymeric and

organic/inorganic self-assembly, electrochemical processes, and interface dynamics in gases and liquids. This symposium aims to provide a platform of discussion to understand the physics and chemistry of materials formation for researchers from various fields.

- Chemical and electrochemical reactions
- Solid-gas interactions
- Nucleation and crystal growth from solutions, melts, and vapors
- Self-assembly, oriented attachment, and nanoparticle-mediated growth
- Developments in specialized holders and electron microscopes, data analysis and mining, and practical challenges for microscopy.

P06 - Nanoscale Optics with Electrons and Photons

ORGANIZERS:

Luiz Tizei, *Université Paris-Saclayniversite*
Sophie Meuret, *Center for Materials Elaboration and Structural Studies*
Sean Collins, *Leeds University*

The optical response of a system is intimately related to its structure and chemistry. For heterogeneous objects, with nanometer scale anisotropy (either chemical or structural), macroscopic optical measurements provide at best the average response requiring extensive modelling for a full picture. In this symposium, we will discuss the use of electron spectroscopies to understand the optical properties of nanomaterials. More precisely, the symposium will address how optimally to couple optical property measurements to other nanometer-scale resolved structural and chemical data. We will emphasize the use of complementary and correlative techniques to reveal the link between structure and optics at the nanoscale.

- Electron energy loss, electron energy gain and cathodoluminescence for optics
- Nanometer/atomic scale structural and chemical measurements
- Optical effects of local changes in composition
- Applications to different systems, such as: moire structures in 2D materials bilayers for photonics, semiconductor heterostructures (emission and absorption), single object (nanowires, nanotubes, molecules...) and optical spectroscopy.

P07 - Correlative Microscopy and High-Throughput Characterization for Accelerated Development of Materials in Extreme Environments

ORGANIZERS:

Yang Yang, *Pennsylvania State University*
Janelle Wharry, *Purdue University*
Xing Wang, *Pennsylvania State University*

The growing demand for carbon-free energy worldwide can only be met by advanced energy systems, such as Gen IV nuclear reactors, molten salt energy storages, and advanced turbines, which require robust materials for higher temperature, more corrosive and more radioactive environments. This symposium will discuss how advanced microscopy techniques are leveraged to meet the crucial need to rapidly introduce new and high-performance materials. High-throughput methodologies enabled by fast detectors, artificial intelligence and automated characterization could potentially be one of the solutions. On the other hand, the combination of multiple characterization techniques on the same sample (a.k.a. correlative microscopy), including electron microscopy, X-ray synchrotron radiation characterization, atom probe tomography, and positron annihilation microscopy, etc., is playing an important role in deciphering the fundamental mechanisms of materials degradation in extreme environments. Discussions on other advanced methods such as in situ techniques and tomography are also encouraged.

- Nuclear Fuel and Materials
- Correlative Microscopy
- High-Throughput Characterization
- Extreme Environments
- Materials Degradation

P08 - Electron Microscopy of Beam Sensitive Samples: The Trials and Tribulations of Electron-beam Sample Interactions

ORGANIZERS:

Joe Patterson, *University of California, Irvine*
Hector A Calderon, *Instituto Politecnico Nacional (Mexico)*
Christina Kisielowski, *Lawrence Berkeley National Laboratory*
Jennifer Cookman, *University of Limerick*

Understanding, controlling and reducing electron-beam sample interactions is essential to meaningfully correlate the synthesis, chemistry and properties of organic and inorganic materials. This becomes especially important and challenging for electron tomography, analytical techniques and in-situ experiments of beam sensitive materials. This symposium welcomes contributions that address challenges in electron-beam sample

interactions that enable the reliable collection of data that advances our understanding of material structures, properties, and dynamics. Topics and techniques of interest include: low-dose imaging, sample preparation, sensitive detectors, exit wave reconstruction, fast scanning and image overlapping, pulsed beams, machine learning, aloof and event-streamed spectroscopy, and theoretical aspects of electron-sample interactions.

- Precise control over the incident electron beams in time and space
- Theoretical understanding of electron-sample interactions
- Low-dose collection and protective sample preparation methods
- High spatial / temporal resolution imaging of beam-sensitive materials
- Automation and machine learning for experiments and analysis.

P09 - Insights into Phase Transitions in Functional Materials by in situ/operando TEM: Experiment Meets Theory

ORGANIZERS:

Leopoldo Molina-Luna, *Technische Universität Darmstadt*

Judy Cha, *Yale University*

Michele Conroy, *University of Limerick*

Lin Zhou, *Ames Laboratory*

Recent technological advances in transmission electron microscopy are transforming what researchers can study at the atomic scale. The capability to perform multiple measurements while simultaneously analyzing corresponding structural, chemical, or even electronic structure changes in nanomaterials or devices down to the atomic scale is opening exciting new opportunities at the forefront of modern materials science research. Phase transformations of nanoscale materials, and corresponding changes in material properties and functionalities, are critical for fundamental science and device applications. In particular, in situ/operando TEM enables direct studies of nucleation and growth during phase transitions in real space, whose pathways and transition kinetics are subject to nanoscale heterogeneities. The focus of this symposium is on the application of in situ/operando TEM techniques that include heating, biasing, cooling, magnetic fields, and mechanical testing to induce and probe phase transitions in functional materials and devices at the nanoscale that, in synergy with theoretical methods, such as DFT calculations, phase-field, micromagnetics, modelling, finite-element based simulations, help unravel the structure and properties of materials down to the atomic scale. Furthermore, as data collection, analysis and recording of dynamic information is

becoming increasingly demanding, we also welcome contributions in computer-aided image analysis and big data processing to understand the fundamental physics governing the nano- to atomic-scale phase transitions of functional materials and devices.

- Phase transitions in functional materials and devices
- In situ TEM capabilities (heating, biasing, cooling, magnetic fields, mechanical testing)
- Synergies with theoretical methods (first-principles, phase-field, micromagnetics, finite-element)
- Monitoring changes in chemical composition and band gap via time-resolved direct electron detection EELS
- Combination with advanced TEM techniques (phase related, spectroscopy, 4D-STEM) and controlled electron-beam-induced transitions.
- Computer-aided image analysis (including AI for EM) for quantitative studies.

P10 - Advanced Imaging and Spectroscopy for Nanoscale Materials

ORGANIZERS:

Robert F Klie, *University of Illinois Chicago*
Shize Yang, *Arizona State University*
Juan-Carlos Idrobo, *Oak Ridge National Laboratory*

The objective of this symposium is to provide a platform to discuss recent developments in materials characterization enabled by aberration-corrected scanning and transmission electron microscopy. While spatial resolution of better than 60 pm is now possible, aberration-correction has also enabled a large variety of in-situ experiments, new imaging schemes, and multi-dimensional data acquisitions at close to atomic resolution. Furthermore, multimodal imaging and spectroscopy provide an unprecedented opportunity for materials characterization by using a combination of high-speed, high-sensitivity detectors and spectrometers. The chemistry and structure of crystals, interfaces, and defects down to the atomic-scale can now be directly determined under proper experimental conditions. Such capabilities offer a unique perspective to understand the structure-property relationships and pave the way towards material functionality manipulation from the atomic scale. This symposium is intended to facilitate the exchange of information on the latest developments, challenges, and outlooks in the application of advanced imaging and spectroscopy methods on resolving structures and chemistry in various materials systems, including metals, oxides, and semiconductors.

- Hardware developments (e.g., field-free objective lens, fast detectors)

- New imaging modes
- Atomic-scale spectroscopy (electron energy loss-spectroscopy, energy dispersive x-ray spectroscopy)
- Applications of aberration-corrected electron microscopy to nanoscale materials characterization.

P11 - Planetary-materials Characterization in the Era of Mission Returned Sample Analysis

ORGANIZERS:

Tom Zega, *Lunar and Planetary Laboratory - University of Arizona*

Jessica Barnes, *University of Arizona*

Harold Connolly Jr., *Rowan University*

Pierre Haenecour, *Lunar and Planetary Laboratory - University of Arizona*

Missions to collect planetary materials from varied celestial sources have provided us with new insights into the early solar system. We expect the return of material from carbonaceous asteroid Bennu by the NASA OSIRIS-REx Mission in just over 14 months. The proposed symposium solicits papers that use microscopy-related techniques in determining the origins of planetary materials. We welcome papers that include but are not limited to: discussing desirable levels of precision or detection, improved methods for sample handling and preparation, and new analytical protocols combining multiple techniques to maximize the information that can be acquired from a small sample.Earth and planetary materials characterization.

- Sample-return missions
- Coordinated analysis and correlative microscopy.

P12 - Memorial Symposium: John C.H. Spence

ORGANIZERS:

Ondrej Krivanek, *NION*

Jian-Min Zuo, *University of Illinois*

John Charles Howorth Spence, FRS (foreign member) made a broad range of fundamental advances in our knowledge of the nanoworld through electron microscopy, electron diffraction, and bio-XFEL. His contributions were always highly original, and typically blazed new paths that others followed. He authored a number of key papers and several widely read textbooks, and tutored many students and postdocs who later made their own

pivotal advances. He also authored a highly acclaimed popular science book and a touching biography about his father, a WWII flying ace. This symposium will cover the fields he contributed in, and chart their future course.

Cross-Cutting Sciences Symposia

C01 - Microscopy Infrastructures: Architectures, Avenues and Access

ORGANIZERS:

Steven Spurgeon, *Pacific Northwest National Laboratory*
Lewys Jones, *Trinity College Dublin*
Zineb Saghi, *De la recherche à l'industrie*
Santhana Eswara, *Luxembourg Institute of Science and Technology*

Modern microscopy drives new scientific discovery, and new scientific practice is driving innovations in microscopy. Hardware and software developments are reshaping how instruments are priced, purchased, designed, and operated. Todayâ€šÃ„Ã´s dynamic research landscape requires us to shift from traditional, closed operating models toward open, agile characterization platforms designed to shorten time to solutions. The field also increasingly demands better value for funders; asynchronous, remote access models; and emphasis on infrastructure resilience. We will explore emerging reprogrammable instrument architectures, new modes of automated/remote operation, and host critical dialogue on the growing cost-driven divide between technological, haves, and, have-nots, among other topics.

- The Microscopy "Maker Space": designing and building reconfigurable, open microscopy platforms
- Data-driven, automated or remote operation modes to achieve novel experimentation, resilience, and greater sample throughput
- Reassessing central-facility versus regionally-distributed models to democratize the atomic world
- Virtual learning and acclimation before utilization
- Instrument sustainability, lifecycle, and end-of-life repurposing
- Maximizing instrument meaning and value: reassessing characterization needs vs. wants.

C02 - Microscopy and Education

ORGANIZERS:

Juan Pablo Hurtado Padilla, *Smithsonian Institution*
Scott Whittaker, *Smithsonian*

Microscopy and Education are complementary and inter-sectional fields. The use of microscopes in any STEM field at any age or academic level is ideal, as they can provide a clear bridge between our visual interpretation of the world and a wide variety of science topics. Furthermore, the principles of microscopy itself are practical examples of the real-world application of otherwise abstract subjects such as math, physics, chemistry and biology. This allows microscopes to be instruments than can equalize the access to science to many different audiences, even those with no direct relation to the scientific world. The Microscopy and Education symposium will provide an space for educators, microscopists and scientists to learn about experiences and proposals that push novel approaches to the use of microscopes as educational tools.

- Microscopes as educational tools
- Microscopy for diverse student audiences
- Microscopy as a window for science education
- The use of microscopes by and for non-traditional audiences
- Microscopes as real-world applications of STEM subjects.

C03 - Facilities Management Crucial Skills and Strategies

ORGANIZERS:

Luisa Amelia Dempere, *University of Florida*
John Shields, *University of Georgia*
Caitlin Tibbetts, *University of Florida*

This symposium will focus on critical skills and strategies that can help core, multiuser facility managers to navigate more effectively essential functions of their role. These skills and strategies will be addressed as follows: Communication model designed to create desired outcomes in crucial conversations with users, higher administration, and stakeholders. Adoption of proven strategies to effectively influence the behavior of users, and their adoption of rules, procedures, and guidelines. Exposure to negotiation strategies

that can effectively address staff and facility needs, use contracts expectations, user-facility agreements, proposal support, publications authorship, facility recognition and acknowledgement, and activities open for negotiation.

- Management Skills
- Management Strategies
- Crucial Conversations with Users
- Influencing Users Behavior
- Negotiation Strategies

C04 - Artificial Intelligence, Instrument Automation, and High-dimensional Data Analytics for Microscopy and Microanalysis

ORGANIZERS:

Huolin Xin, *University of California, Irvine*

James LeBeau, *Massachusetts Institute of Technology*

Markus Kuehbach, *Humboldt-Universität z u Berlin*

Priyanka Periwal, *University of Texas at Austin*

The development of increasingly sensitive detectors and higher frames rates of acquisition are driving the development of new image analysis methods. These include the rapid development and application of advanced artificial intelligence methods such as machine learning and automation. Many of these developments are happening within the broader framework of open-source software development and can exploit open data. Open-source software can further enable researchers to design, collaborate, and share experimental techniques without the limitations of proprietary software. These developments are intertwined with issues regarding data storage, handling, and management, and are aided by adherence to Findable, Accessible, Interoperable, Reusable (FAIR) data principles. We welcome submission in the following topical areas.

- Application of artificial intelligence to microscopy and spectroscopy
- Healing, inpainting, and compressed sensing of discrete or contaminated microscopy and spectroscopy datasets
- Discovery of hidden correlations and inverse problems
- Efficient storage, handling, and management of large-volume/high-dimensional data
- Open software and open frameworks for microscopy and spectroscopy
- Ontology and infrastructure tools which support microscopists with aligning the above-mentioned analyses better with the aims of the FAIR data stewardship principles

C05 - Vendor Symposium

This symposium is a forum for vendors to highlight important breakthroughs in technology and methodology developed by companies working at the cutting edge of microscopy, microanalysis, and image processing. It covers new instrumentation, technologies and methods that advance all fields of microscopy and microanalysis for both physical and biological sciences. It will provide an open forum for the exchange of ideas and best practices.

(https://www.microscopy.org/)

(http://www.microbeamanalysis.org/)

(http://www.msc-smc.org/)

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Plenary Session Speakers

Wendy Garrett, MD, PhD

Health versus disease: the facts in the case of the microbiota

Wendy Garrett is the Irene Heinz Given Professor of Immunology and Infectious Diseases at the Harvard T. H. Chan School of Public Health and a Professor of Medicine at Dana-Farber Cancer Institute and Harvard Medical School. She is co-director and co-founder of the Harvard Chan Microbiome in Public Health Center. Dr. Garrett's team explores interactions between the gut microbiome and the immune system, both in physiological and pathological conditions, with a focus on inflammatory bowel diseases and colorectal cancer. Her team has identified microbial species, functions, and metabolites influencing host health and disease by using an interdisciplinary approach bridging meta'omics, microbiology, cellular immunology, biochemistry, cell biology, and cancer biology. The mission of Dr. Garrett's lab is to identify basic biologic mechanisms to be applied to precision medicine.

Stony Brook University | Alan Alda Center for Communicating Science

Alda Science Communication Experience

Science is complex. It shouldn't be exclusive.

James Rea - Instructor

For more than 20 years, James has rooted around in dense thickets of scientific and public policy content, searching for the stories that shine. He found this calling in 1996 at the US Environmental Protection Agency, where he translated vital scientific research into language the public would understand and remember. James further honed his skills as an independent reporter for National Public Radio, crafting stories most often for WAMU 88.5 FM in Washington, DC. As the 21st century dawned, James founded the production firm Site Stories to help technical organizations share their stories through web videos. By 2011, James had interviewed countless experts. He knew how to find the gold in their stories and wanted to help them do the same. He now follows this passion through his own firm Experts/Clearly, and as an instructor with the Alan Alda Center for Communicating Science.

The Alda Science Communication Experience is the Center's signature professional development program. Through a series of options, scientists will explore strategies to engage their audiences in ways that build trust and inspire.

Because all people understand the world through their individual experiences, this program will help researchers invite their audiences into their work. Through active listening and close attention to non-verbal communication, participants will learn to build connections between their research and other people's backgrounds and experiences.

(https://www.microscopy.org/)

(http://www.microbeamanalysis.org/)

(http://www.msc-smc.org/)

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Pre-Meeting Congresses

X60 — Annual Pre-Meeting Congress for Students, Post-Docs, and Early Career Professionals in Microscopy & Microanalysis (/MandM/2022/program/congress_x60.cfm)

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

X61 — Pharmaceutical, Biopharmaceutical, and Medical Health Products (/MandM/2022/program/congress_x61.cfm)

Organized by the MSA Pharmaceuticals Focused Interest Group

X62 — Real-World Data Analytics & Quantitative Liquid and Gas Environmental Electron Microscopy (/MandM/2022/program/congress_x62.cfm)

Organized by the MSA Electron Microscopy in Liquids and Gases Focused Interest Group

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Sunday Short Courses

Sunday, July 31, 2022

- **All short courses start at 8:30 AM and end by 5:30 PM.**
- **Separate registration fee required — see registration form.**
- **A certificate of attendance will be emailed to each participant.**
- **Mid morning and mid afternoon breaks are provided**
- **Breakfast and lunch are on your own**

X-10 High-Resolution Structure Determination by Cryo-EM - Rescheduled for M&M 2023 - Minneapolis, MN

X-11 Explaining the New World Order of Biological Fluorescence Microscopy

LEAD INSTRUCTORS:

Bob Price

University of South Carolina School of Medicine

E-mail (mailto:Bob.Price@uscmed.sc.edu)

Jay Jerome

Vanderbilt University

E-mail (mailto:jay.jerome@Vanderbilt.edu)

- Basics of fluorescence
- Basics of confocal microscopy
- New fluorescence imaging modes
- Selection of appropriate imaging modes

Fluorescence microscopy is a primary method for visualizing structure in three dimensions. Since our *Basic Confocal Microscopy* short course more than 10 years ago, tremendous advances in hardware and software have been made that have led to improved imaging depth/3D reconstruction technology and super-resolution imaging techniques such as PALM, STORM, SIM and several variations of these. We will review the basic principles of fluorescence and confocal imaging, provide information on how these principles relate to several new modes of fluorescence imaging, and discuss/compare how these new imaging modes have improved our understanding of fluorescence applications in biological/biomedical research.

X-12 Guidelines for Performing 4D-STEM Characterization from the Atomic to >Micrometer Scales: Experimental Considerations, Data Analysis and Simulation

LEAD INSTRUCTORS:

David Muller

Cornell University

E-mail (mailto:david.a.muller@cornell.edu)

Colin Ophus

Lawrence Berkeley National Laboratory

E-mail (mailto:clophus@lbl.gov)

- 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

With modern electron detector technology, it is now possible to record full images of a converged STEM probe while scanning it over the sample surface, resulting in a 4D-STEM dataset. Because the atomic-scale scattering information contained in an atomic-scale STEM probe is decoupled from the step size between STEM probe positions, 4D-STEM can be used for experiments ranging from sub-Angstrom resolution phase contrast imaging to statistical characterization of functional materials over large length scales. In this course, we will give tutorials on how to perform 4D-STEM experiments, analyze the (potentially very large!) resulting datasets, and perform 4D-STEM simulations.

X-13 SerialEM for EM Data Acquisition

LEAD INSTRUCTORS:

Cindi Schwartz

Rocky Mountain Laboratories/NIAID/NIH

E-mail (mailto:cindi.schwartz@nih.gov)

Jason de la Cruz

E-mail (mailto:delacrm1@mskcc.org)

- Installation, calibration, and operating concept of SerialEM
- Image acquisition techniques such as for tilt-series, single-particle, and micro-ED
- Ancillary hardware such as direct-electron detectors, energy filters, and phase plates
- Scripting to extend SerialEM

Developed by David Mastronarde at the University of Colorado, SerialEM is open-source and widely used in automated TEM data acquisition on a multitude of microscope platforms and detectors. The course will be of interest to both beginners and advanced users in both biological and materials sciences. Installation and calibration of SerialEM will include use of direct-electron detectors and imaging energy filters. Imaging techniques such as tilt-series acquisition, low-dose imaging, single-particle acquisition, montaging, and mapping, as well as use of scripts (macros) and working with the navigator file or image data to extend SerialEM beyond its native capabilities will be covered.

X-14 In Situ and Operando Approaches to TEM

LEAD INSTRUCTORS:

Robert Sinclair

Stanford University

E-mail (mailto:bobsinc@stanford.edu)

Peter Crozier

Arizona State University

E-mail (mailto:CROZIER@asu.edu)

Course Agenda (/MandM/2022/program/X-14.pdf)

This course will introduce the fundamental concepts for in situ electron microscopy. It will include topic such as:

- Hot stages
- Gas cells
- Liquid cells

- Biasing holders
- Magnetic field
- Light illumination

In situ and operando transmission electron microscopy are becoming increasingly important in advanced materials characterization. Being able to observe materials in state that are similar to real world applications is now recognize as vital for relating structure to functionality. The ability to perform atomic level analysis while the sample is exposed to different stimuli/environments such as heat, strain, gas, liquids, electric field, magnetic field, light, etc.â€¦is a key part of the in-situ approach. Operando approach require simultaneous measurement of some technologically relevant functionality such as current flow, deformation or catalysis.

X-15 Cryo-STEM and EELS for Materials Sciences

Lead Instructors

Ismail El Baggari
Harvard University

Myung-Geun Han
Brookhaven National Laboratory

Michael Zachman
Oak Ridge National Laboratory

Course Agenda (/MandM/2022/program/X-15.pdf)

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-16 Data Analysis in Materials Science

LEAD INSTRUCTORS:

Eric Prestat

University of Manchester and SuperSTEM Laboratory, UK

E-mail (mailto:eric.prestat@manchester.ac.uk)

Joshua Taillon

National Institute of Standards and Technology, Boulder, US

E-mail (mailto:joshua.taillon@nist.gov)

- Introduction to HyperSpy and related Python libraries for multi-dimensional image and spectra processing and analysis.
- Curve fitting of multi-dimensional datasets.
- Machine learning.
- Big data analysis strategies.
- EELS and EDS analysis.
- Optional: application to the analysis of atomic resolution images, scanning electron diffraction and 4D STEM datasets.

This short course will introduce the use of HyperSpy and related Python libraries (atomap, pixStem, pyXem) for analysis of microscopy datasets. No prior Python knowledge is required. Attendees will learn how to perform basic machine learning, multi-dimensional curve fitting for EELS and EDS quantification, atomic resolution image analysis and big data processing (such as 4D STEM) on desktop computers. **For this hands-on and interactive short course, attendees will need to install software on their own laptop in advance and bring it with them to the short course (instructions will be provided).**

X-17 Biological EM Sample Processing

Lead Instructors

Ru-ching Hsia

Carnegie Institution for Science

Alice Liang

NYU Langone's Microscopy Laboratory

Kirk Czymmek

Donald Danford Plant Science Center

- Basic biological EM sample processing, conventional workflow and basic reagents
- Particulate biological sample processing, agarose enrobing, negative staining
- Ultramicrotomy: Instrumentation, techniques and tips and tricks
- Special considerations for common biological EM specimen, specimen orientation, location of ROI, etc.
- Conventional biological EM sample processing for scanning electron microscope
- Rapid EM sample processing workflow, instrument assisted and automated sample processing and others

This course is the first installment of a two-part series of biology EM courses designed to introduce the principles and workflow of EM sample processing for animal and plant tissues, cultured cells, microorganisms and other particulate specimens. Participants do not need to have prior EM sample processing experience. The second installment (Part 2) of this course will be offered in 2023 and will include more advanced EM sample processing techniques.

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Biological Sciences Tutorials

X41 - Applying CryoAPEX in the Cell Biology of RNA Viruses; A Question-Based Evolution of the Methodology

Cancelled for 2022

X42 - Indirect correlative light and electron microscopy (*i*CLEM)

ORGANIZERS:

Heather Struckman, *The Ohio State University*

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

- *i*CLEM exploits structural fiducials in samples that are identifiable via both light and electron microscopy to correlate distributions of measurements rather than individual images.
- This sidesteps the need to image samples on two different microscopes.
- *i*CLEM incorporates computational image analyses designed for rich quantitative assessment and high throughput.

Physical Sciences Tutorials

X43 - A Multi-Modal Approach for Characterizing Battery Materials

Cancelled for 2022

X44 - Precession Electron Diffraction: A Little Bit of History, Basics, and Recent Developments in Projected Crystal Symmetry Quantifications

Cancelled for 2022

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Microscopy Outreach Sessions

X91: Microscopy Explorations for Families and Kids of All Ages

(formerly "Family Affair")

Organizers:

Elaine Humphrey, University of Victoria, Canada

Pat Connelly, National Institutes of Health

Please check back on the M&M 2022 website ("Scientific Program" – "Outreach") for updated information about this session.

X92: Project MICRO

Organizers:

Elaine Humphrey, University of Victoria, Canada

Janet Schwarz, University of Vermont

Pat Connelly, National Institutes of Health

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.

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. In response to education changes in 2020, ***The HTA Inspire STEM Education Outreach Program*** has put forth a plan to provide an opportunity to make quality in-person and virtual experiences easily accessible to teachers as they create the classrooms of tomorrow now. The program is continuing its work with local, national, and international partners to provide flexible access to easy to use content and technology that can be used in the following learning scenarios: *Brick to Click Learning, Click to Brick Learning , Blended Learning and Online Learning*.

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

Participants are welcome from the following areas: Academia, Education, all levels of Government, Business/Industry, and change leaders within Science, Technology, Engineering, and Math sectors.

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Technologists' Forum

X30 - Technologists' Forum Roundtable: Image Data Analysis Software Review

With the introduction of new 3D imaging microscope systems, data size and complexity has increased requiring more advanced software to analyze the results. Although many classic data analysis programs exist, there has been the development of new programs that are stand alone or integrated into microscope systems that have enhanced capabilities and improved user interfaces. This session will review a few new programs used to analyze data from whole slide scanners, light sheet imaging systems and 3D fluorescent image data.

- Analysis of whole slide scanner data using deep learning AI for multiplex data.
- Automated 3D analysis workflows for Light sheet, SEM, FIB-SEM, CLEM and other volume image data sets.
- 3D/4D visualization and analysis for cell-based segmentation, automated tracking and identification of intracellular relationships within 3D fluorescent image data sets.

ORGANIZERS:

D. Page Baluch, *Arizona State University*

Frank P. Macaluso, *Albert Einstein College of Medicine*

X31 - Technologists' Forum Symposia: 3D SEM Techniques

Interest in three-dimensional scanning electron microscopy has increased over the past few years with the expanded capability to combine Correlative Electron Microscopy (CLEM) with 3-D volume analysis. As more tools and workflows become available, the techniques in sample preparation and data analysis are still challenging. This year the Technologists'

Forum is partnering with the organizers of the 3D Volume Electron Microscopy in Biological Science symposium to provide a series of presentations that focus on sample preparation, image acquisition and analysis.

- Review of the challenges and new developments in sample preparation for volume EM.
- Experimental design and workflows for sample preparation, image acquisition and analysis.
- Tips and tricks on 3-DSEM image acquisition and analysis.

ORGANIZERS:

D. Page Baluch, *Arizona State University*
Ru-Ching Hsia, *Carnegie Institution for Science*

X32 - Technologists' Forum Workshop — Tissue Clearing Tips & Techniques

With an increased interest in 3D tissue imaging, researchers have had to develop protocols to optically clear thick tissues for light microscopy-based applications. Tissue clearing is now combined with many other techniques such as multiplexing protein imaging, fluorescent in situ hybridization for DNA and RNA, super-resolution imaging techniques, and multiomics studies. This year the Technologists' Forum is partnering with the organizers of the Development, Challenges and Biomedical Applications of Tissue Clearing, Expansion Microscopy and Volumetric Imaging symposium to provide a series of presentations that will review the most common protocols used in tissue clearing, highlighting the challenges, and describing sample processing workflows.

- Identify the clearing technique most suited for your tissue type and imaging method.
- Learn about the most common clearing techniques used in light-based microscopy.
- Tips in avoiding tissue or objective lens/microscope system damage.

ORGANIZERS:

D. Page Baluch, *Arizona State University*
John L. Grazul, *Cornell University*
Ru-Ching Hsia, *Carnegie Institution for Science*

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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

Scientifically significant micrographs:

Published category (images published in 2021)

Open category (unpublished images)

Video category (movies and 3-D reconstructions)

Deadline for submission is February 17, 2022

Prizes awarded at M&M 2022 in Portland, OR

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2022 Society Award Winners

Distinguished Scientist Awards

These Awards recognize preeminent senior scientists from both the Biological and Physical disciplines who have a long-standing record of achievement during their career in the field of microscopy or microanalysis.

Distinguished Scientist

Biological Sciences

Kenneth A. Taylor (/awards/bios/dsa_biological_2022.cfm)

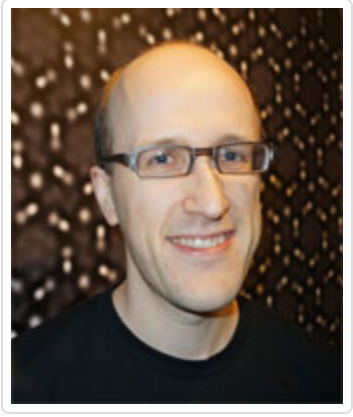
Distinguished Scientist

Physical Sciences

Rudolf Tromp (/awards/bios/dsa_physical_2022.cfm)

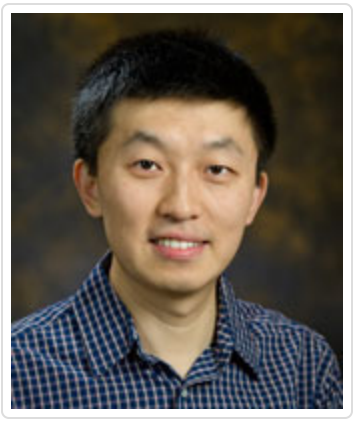
Burton Medal

The Burton Medal was initiated to honor the distinguished contributions to the field of microscopy and microanalysis of a scientist who is less than 40 years of age on January 1st of the award year.



Burton — Physical

Colin Ophus (/awards/bios/burton_physical_2022.cfm)



Burton — Biological

Yuan He (/awards/bios/burton_biological_2022.cfm)

Outstanding Technologist Awards

These Awards honor technologists from both the Biological (Hildegard H. Crowley Award) and Physical Sciences (Chuck Fiori Award) who have made significant contributions such as the development of new techniques which have contributed to the advancement of microscopy and microanalysis.

Hildegard H. Crowley Award

Janice Green Pennington (/awards/bios/crowley_2022.cfm)

Chuck Fiori Award

Hendrik O. Colijn (/awards/bios/fiori_2022.cfm)

Morton D. Maser Distinguished Service Award

This Award was initiated to recognize outstanding volunteer service to the Society as exemplified by Mort Maser, who served the Society for many years with great dedication. This award is made to honor an MSA member who has provided significant volunteer service to the Society over a period of years.

Edward Patrick Calomeni (/awards/bios/maser_2022.cfm)

The George Palade Award

The George Palade Award was initiated to recognize the distinguished contributions to the field of microscopy and microanalysis in the life sciences of a postdoctoral fellow of not more than 6 years' standing (since doctoral graduation).

Melody G. Campbell (/awards/bios/palade_2022.cfm)

The Albert Crewe Award

The Albert Crewe Award was initiated to recognize the distinguished contributions to the field of microscopy and microanalysis in the physical sciences of a postdoctoral fellow of not more than 6 years' standing (since doctoral graduation).

Jordan Adam Hachtel (/awards/bios/crewe_2022.cfm)

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