Call for Papers

Submission Deadline:
February 15, 2019

Look Inside for Program Details, Plenary Speakers, Pre-Meeting Congresses, and more!

www.microscopy.org/MandM/2019
for up-to-date meeting information
On behalf of the Microscopy Society of America, the Microanalysis Society, and the International Field Emission Society, we invite you to join us August 4-8, 2019, for Microscopy & Microanalysis 2019 at the Oregon Convention Center in Portland, Oregon. This will be the fourth M&M meeting held in the City of Roses. It’s an excellent venue with wonderful restaurants, lots of activities for the family, and a comfortable climate with August highs near 80°F (27°C).

The Program Committee, led by Alice Dohnalkova, Huolin Xin, Assel Aitkaliyeva, and Baptiste Gault, has developed an exciting group of symposia, spanning advances in instrumentation and techniques development, as well as applications in the analytical, biological, and physical sciences. We encourage you to browse the Call for Papers for the complete symposium list, and to submit one or more scientific papers for platform or poster presentation. Tables will continue to be provided at the poster boards for fully dynamic multimedia poster presentations.

The main meeting will be preceded by the ever-popular Sunday Short Courses, two Pre-Meeting Congresses, and will officially start with the Opening Welcome Reception on Sunday evening. The Sunday reception is a great place for all attendees to meet new colleagues and reconnect with old friends. Students and early-career professionals are especially encouraged to participate in the MSA Student Councillor Pre-Meeting Congress that highlights outstanding work by student and postdoctoral fellow attendees. On Monday morning, the Plenary Session kicks off the scientific program with two exciting plenary lectures, and the presentations of the M&M meeting awards and awards from the sponsoring societies. We are excited to announce that two of the 2017 Nobel Prize winners in Chemistry, Professors Joachim Frank and Richard Henderson, will be our 2019 Plenary Speakers. Please join us in welcoming back these long-time MSA members and frequent M&M attendees as they discuss their groundbreaking work in cryo-electron microscopy.

In addition to the strong scientific program, what sets the M&M meeting apart is the Exhibit Hall, the world’s largest annual microscopy exhibition, which showcases the latest in microscopy instrumentation and accessories. Don’t miss the highly popular vendor tutorials, held Monday through Wednesday after hours in the Exhibit Hall. Other educational opportunities throughout the week include focused biological and physical science tutorials, educational outreach programs, and our Technologists’ Forum special and roundtable sessions.

In short, M&M 2019 will be an outstanding opportunity to stay abreast of the latest technologies, hear about new developments in applications across all areas of microscopy and microanalysis, and most importantly network with colleagues.

We hope to see you in Portland!

Paul Kotula, Sandia National Laboratories  
President, Microscopy Society of America

Rhonda Stroud, U.S. Naval Research Laboratory  
President, Microanalysis Society

David Larson, AMETEK, Inc.  
President, International Field Emission Society

Ted Kinsman - Rochester Institute of Technology - Extremophile Community
B01 Multi-Modal, Large-Scale, and 3D Correlative Microscopy
James Fitzpatrick, Washington University School of Medicine
Jacob Hoogenboom, Delft University of Technology, Netherlands
Ben Giepmans, University Medical Center Groningen, Netherlands
- Multi-Modal Microscopy
- Correlative Microscopy (CLEM)
- Large-Scale Volume EM
- Data Recognition and Modeling
- Novel Probes and Sample Preparation Workflows
- New Hardware and Instrumentation

B02 Element Analysis of Biological Materials
Peta Clode, University of Western Australia
Stefan Vogt, Argonne National Laboratory
Nicole Hordow, University of Leeds, United Kingdom
- Element & Isotopic analysis
- Cell & tissue mapping
- Electron, ion, & X-ray sources
- Bio-nanotechnology
- Biomimetics

B03 Utilizing Microscopy for Research and Diagnosis of Diseases in Humans, Plants and Animals
Ru-ching Hsia, University of Maryland-Baltimore
Marcela Redigolo, West Virginia University
Han Chen, Penn State College of Medicine
- Microscopic characterization of cellular and molecular structure in normal and diseased humans, animals and plants
- Applications of microscopic imaging for basic and clinical research with emphases in technical development and implementation
- Investigation of organisms and their related pathogens in clinical and research laboratories
- Techniques that improve rapid detection of pathogens and accurate diagnosis, for example, quantitative microscopy, nanomaterials in diagnosis, imaging cytometry, high throughput microscopy, automation of microscopy, etc.

B04 Cutting Edge Microscopy in the Pacific Northwest
Douglas Keene, Shriners Hospital for Children
Claudia Lopez, Oregon Health & Science University and Pacific Northwest Center for Cryo-EM
- Cryo-electron microscopy: best approaches for data collection and analysis
- Pushing the limits of super-resolution fluorescence microscopy
- Quantitative analysis in microscopy
- 3D microscopy
- Novel approaches for correlative light and electron microscopy
- Data mining, machine learning approaches to analyze large electron and optical microscopy datasets

B05 Light and Fluorescence Microscopy for Imaging Cell Surface and Structure
Justin Taraska, NIH - Laboratory of Molecular & Cellular Imaging
David Zenisek, Yale University School of Medicine
David Perras, CNRS UMR, Institut interdisciplinaire de Neurosciences, France
Xiaolin Nan, Oregon Health Sciences University
- Confocal, light sheet, and expansion microscopy research topics
- Immunocytometry in current cell biology research
- Total Internal Reflection Microscopy (TIRF): Research derived from insights and works by Christien J. Merrifield
- Polarization optics
- Fluorescence reporter proteins, fluorescent protein development and characteristics
- Related correlative microscopies

B06 Pharmaceuticals FIG – Imaging, Analysis, and Regulation of Medical Products, Devices and Data Integrity
Gianpiero Torraca, Amgen, Inc.
Daniel Skomski, Merck Research Laboratories
- Novel microscopic or spectroscopic methods applied to biomedical/biotechnological areas
- Pharmacology challenges (polymorphs, contaminants, particles, etc.)

B07 3D Structures: from Macromolecular Assemblies to Whole Cells (3DEM FIG)
Melanie Ohi, University of Michigan Life Sciences Institute
Elitza Tocheva, University of British Columbia, Canada
Teresa Ruiz, University of Vermont
- Structure and function of macromolecular complexes in vitro and in vivo
- Single particle cryo-electron microscopy
- Cryo-electron tomography

B08 Cryo-EM - from Physics to Cell Biology: Honoring the Remarkable Legacy of Ken Downing
Melanie Ohi, University of Michigan Life Sciences Institute
Eva Nogales, University of California-Berkeley, Lawrence Berkeley National Laboratory
- Cryo-electron microscopy
- Microtubule structure and regulation
- Electron crystallography

B09 From Images to Insights: Working with Large Data in Cell Biological Imaging
Kedar Narayan, National Cancer Institute
Camenzind Robinson, St. Jude Children’s Research Hospital
Jonathan Lefman, NVIDIA Corporation
- Processing, storing, and distributing large image data in cell biology
- Correlating images and metadata from LM, EM, and other modalities (XRM, chemical imaging, etc.)
- Extracting, segmenting, and visualizing features of interest efficiently
- Adapting and applying open-source tools and frameworks
- Scalable solutions for small and mid-sized labs and facilities
P01 In situ TEM Characterization of Dynamic Processes During Materials Synthesis and Processing
Dongsheung Li, Pacific Northwest National Laboratory
Haimei Zheng, Lawrence Berkeley National Laboratory and University of California-Berkeley
Liang Jin, Direct Electron
Yu Han, King Abdullah University of Science and Technology, Saudi Arabia

- Nucleation and crystal growth from solutions, melts, and vapors
- Technical advances, applications and practical experiences associated with electrochemical processes including batteries, water splitting, fuel cell, and photoelectrochemistry
- Developments in specialized holders and electron microscopes, data analysis and mining, and practical challenges for microscopy
- Chemical and electrochemical reactions
- Polymeric and organic/inorganic self-assembly and nanoparticle mediated growth and oriented attachment
- Solid-gas interaction

P02 Microscopy and Microanalysis of Nuclear and Irradiated Materials
Chad Parish, Oak Ridge National Laboratory
Khalid Hattar, Sandia National Laboratories
Peter Hosemann, University of California–Berkeley
Assel Aitkaliyeva, University of Florida

- Fission, fusion, accelerator, and space materials: metals, ceramics, polymers, semiconductors, fuels, etc.
- Damage phenomena: dislocation loops, segregation and precipitation, stacking fault tetrahedral, etc.
- Microscopy via SEM, TEM, aberration-correction, in situ microscopy, etc.
- Microanalysis via microprobe, mass spectroscopy, etc.
- Modelling and theory approaches that aid in interpretation of microscopy data of these phenomena
- Applications of data science to large or sparse microscopy datasets

P03 Revealing the Fundamental Structure of Soft and Hard Matter by Minimizing Beam-Sample Interactions
Joerg Jinschek, The Ohio State University
David Flannigan, University of Minnesota
Dalaver H. Anjum, King Abdullah University of Science & Technology (KAUST), Saudi Arabia
Stig Helveg, Haldor Topsoe A/S, Denmark

- Development of new EM modes such as low-dose / low-dose-rate electron microscopy, low-voltage electron microscopy, ultrafast TEM, or quantum electron microscopy, and their impact on beam-sample interactions
- Studying the effects of sample support, temperature (e.g., cryogenic), and environment (gas, liquid) on beam-sample interactions
- Minimizing electron dose and/or electron dose-rates to prevent radiolysis and displacement damage
- Optimization of the detection of every scattering event by techniques such as phase-plate imaging, direct electron detection, high-speed image acquisition, and new techniques for image processing

Dan Hodoraaba, Federal Institute for Materials Research and Testing (BAM), Germany
Andrew Stewart, University of Limerick, Ireland
Meiken Falke, Bruker Nano GmbH, Germany

- Organic (e.g. polymers) and inorganic (e.g. oxides) compounds, biomaterials; also light elements to be quantified in heavy matrices (e.g. carbon in steel) and light matter with nano-inclusions (e.g. oxide films containing metallic nanoparticles)
- High-resolution spectroscopy techniques for SEM and STEM, e.g. EDS, EELS
- Imaging techniques using e.g. annular detectors to quantify light elements in STEM
- Correlative approaches combining different spectroscopies and imaging to study low-Z materials (e.g. SEM and Raman, SEM and Auger electron spectroscopy, STEM ABF imaging and spectroscopy)
- Simulations and theoretical approaches to quantify light element compositions in electron imaging, EDS, EELS, etc.

P05 Theory and Applications of Electron Tomography in the Materials Sciences
Peter Ercius, Lawrence Berkeley National Laboratory
Robert Hovden, University of Michigan
Sandra Van Aert, University of Antwerp, Belgium

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

P06 In situ TEM of Nanoscale Materials and Electronic Devices for Phase Transformation Studies
Leopoldo Molina-Luna, Technische Universität Darmstadt, Germany
Lin Zhou, Ames Laboratory
Judy J. Cha, Yale University

- In situ TEM development: imaging, acquisition, software
- Development of in situ TEM holders and chips for thermal, electrical, and mechanical excitations
- Phase transformation of nanomaterials by in situ heating and cooling TEM experiments
- Phase transformation by mechanical testing of in situ TEM experiments
- Electric field / current induced phase transformation of functional materials

P07 Electron Crystallography of Nanostructures in Nanotechnology, Materials and Bio-Sciences
Sergei Rouvimov, University of Notre Dame
Roberto Reis, Lawrence Berkeley National Laboratory
Alex Eggeman, University of Manchester, United Kingdom

- Scanning electron diffraction techniques for micro-structure analysis including 4D-STEM, EBSD,SPED, and others
- Electron diffraction methods for soft and biological materials
- New approaches in analysis and simulation in electron crystallography to improve the speed and reliability of structure characterization
- Solving and refining atomic arrangements from electron diffraction data
- Novel strategies in materials research
**P08 Microscopy and Spectroscopy of Nanoscale Materials for Energy Applications**
Chongmin Wang, Pacific Northwest National Laboratory
Matthew T. McDowell, Georgia Institute of Technology
Yuanyuan Zhu, University of Connecticut
- Novel imaging and spectroscopy techniques for structural and chemical evolution of nanoscale materials
- Mass and charge transport in materials with dimensionalities from 0 to 3D
- Multi-scale to atomic-resolution imaging and spectroscopy of materials related to energy harvesting and storage
- Low-dose and low dose-rate imaging and spectroscopy for beam-sensitive nanostructures
- Advances in ultrafast imaging and spectroscopy data collection and interpretation

**P09 The Success of TMBA: TEM and STEM Developments in Techniques, Applications and Education**
Masashi Watanabe, Lehigh University
Joseph Michael, Sandia National Laboratories
Paul Kotula, Sandia National Laboratories
- Advances in TEM and STEM
- Improvements in the analysis of TEM and STEM data
- Educational approaches to teaching of STEM and TEM
- The role of tools and data in education and research

**P10 Applications of Integrated Electron Probe Microscopy and Microanalysis Techniques in Characterizing Natural and Synthetic Materials**
Danggao Zhao, University of Missouri-Kansas City
Minghua Ren, University of Nevada-Las Vegas
Owen Neill, University of Michigan
- Imaging from SE, BSE, X-ray, CL, charge contrast, transmitted electron, diffracted or scattered electron, etc.
- Qualitative and quantitative determination of chemical compositions of natural and synthetic materials
- Repeatability, reproducibility and compatibility of quantitative microanalysis standards
- Crystal structure determination using electron diffraction or electron backscattered diffraction (EBSD)

**P11 Advances in Characterization of Geological and Extraterrestrial Samples**
Bradley De Gregorio, U.S. Naval Research Laboratory
Bobby Hooghan, Weatherford Laboratories
Lori Hathon, University of Houston
- Novel uses of various imaging and analytical techniques to characterize geological samples
- Investigations of natural materials requiring advanced microscopy and microanalysis
- Innovative solutions to long-standing technical challenges for sample preparation and characterization
- New insights into the formation, history, and use of geological and extraterrestrial samples enabled by microscopy
- Micro- and nano-scale studies of minerals, both isolated and ensemble, on the generation, storage, and preservation of organic matter
- Applications of imaging technologies in petroleum exploration and production, including linking imaging and image analysis with laboratory physical property measurements (e.g. porosity, permeability, wettability, strength and acoustic properties), and upscaling properties from the pore to the core scale

**P12 New Frontiers in Atom Probe Tomography Applications**
Baishakhi Mazumder, University at Buffalo
Arun Devaraj, Pacific Northwest National Laboratory
- APT analysis of minerals, biominerals, soft matter, biological tissues
- APT characterization of semiconductor materials and devices
- Investigation of processes limiting the lifetime of engineering materials in service; e.g. corrosion, mechanical fracture, radiation damage, etc.

**P13 Advanced Characterization of Components Fabricated by Additive Manufacturing**
Isabella van Rooyen, Idaho National Laboratory
Subhashish Meher, Idaho National Laboratory
Federico Sciammarella, Northern Illinois University
Cesar Terrazas, The University of Texas-El Paso
- TEM and STEM studies (imaging, EDS, electron diffraction, EELS) to understand phase transformations, microstructural evolution in components produced by various additive manufacturing (AM) processes
- 3D microstructure analysis methods on the micro-, nano-, and atomic scale to understand the integrity of AM fabricated products
- Microstructural response of AM components to post-processing conditions
- Current challenges in analytical tools for microscopy and microanalysis of AM products
- Microstructure and defect analysis by both characterization and modeling for insights into solidification and melt pool dynamics in AM processes
- In situ experiments on AM products
A01 Advances in Phase Retrieval Microscopy
Kai He, Clemson University
Charudatta Phatak, Argonne National Laboratory
Toshiaki Tanigaki, Hitachi Ltd.
Martha McCartney, Arizona State University
• Four-dimensional scanning transmission electron microscopy (4D-STEM)
• In-line and off-axis electron holography
• Electron and X-ray ptychography
• Magnetic imaging (Lorentz TEM, DPC, EMCD, phase plate, etc.)
• New theory, instrumentation, and computational algorithms
• In-situ phase retrieval methods

A02 Data Acquisition Schemes, Machine Learning Algorithms, and Open Source Software Development for Electron Microscopy
Francisco de la Peña, University of Lille, France
Philippe T. Pinard, Oxford Instruments NanoAnalysis, United Kingdom
Eric Prestat, University of Manchester and SuperSTEM, United Kingdom
• Open-source and/or community-driven software development
• Machine learning
• New algorithms and processing workflow
• Novel data acquisition schemes

A03 Low-Energy X-ray Spectroscopy: Novel Applications Using Soft X-ray Emission Spectroscopy (SXES), Cathodoluminescence (CL) and Synchrotron Techniques
Anette von der Handt, University of Minnesota
Emma Bullock, Carnegie Institution for Science
Juliane Gross, Rutgers University
Zach Gainsforth, University of California-Berkeley
• Low energy spectroscopy
• Chemical state analysis
• Trace chemistry
• SXES, CL, XAS, EELS, XPS
• Geological and extraterrestrial materials
• Biological materials

A04 Recent Developments in Atom Probe Tomography
Ty Prosa, Cameca Instruments Inc.
Baptiste Gault, Max-Planck-Institut für Eisenforschung, Germany
David J. Larson, Cameca Instruments Inc.
• New developments in field evaporation theories and mechanisms
• Advances in APT instrumentation and technique development (including FIM)
• Reconstruction improvements and future directions
• Standards development for atom probe tomography

A05 Leveraging 3D Imaging and Analysis Methods for New Opportunities in Material Science
Ashwin Shahani, University of Michigan
Roland Brunner, Materials Center Leoben Forschung GmbH, Germany
Wil Harris, Carl Zeiss Microscopy
Erdmann Speicker, Universität Erlangen-Nürnberg, Germany
• 3D, including repetitive time-lapse ‘4D’, microscopy methods for materials science
• Challenges with respect to big data handling
• Challenges with respect to image processing/analysis
• Linking imaging data with computational methods and modeling

A06 Low Voltage, Low Energy Electron Microscopy Imaging and Analysis
David C. Bell, Harvard University
Natasha Erdman, JEOL USA Inc.
Hector Calderon, Instituto Politécnico Nacional, Mexico
• Low voltage application of TEM, SEM and STEM
• Analytical possibilities with low voltage and low energy electron microscopy
• New designs of electron microscopes for low voltage or energy operation
• Materials preparation consideration for low voltage/low energy operation

A07 Vendor Symposium
Elizabeth Dickey, North Carolina State University
Deborah Kelly, Virginia Carilion Research Institute
• New methods and techniques; new developments and technologies
• Breakthroughs and new instrumentation
• Improvements to existing instrumentation

A08 Current Trends and Challenges in Electron Energy-Loss Spectroscopy
Patricia Abellan, SuperSTEM Laboratory, United Kingdom
Matthieu Bugnet, University of Lyon – CNRS, France
Peter Crozier, Arizona State University
Xiaoping Pan, University of California-Irvine
• Recent advances in acquisition, processing and modelling of low energy-loss EELS
• Latest developments in core-loss EELS acquisition
• Fundamental electron matter interaction (molecular/solid level) at the (sub)nanometer scale
• Non-destructive characterization of chemical bonding of functional groups and adsorbates at surfaces and interfaces
• Fundamentals and applications of vibrational EELS

A09 Microscopy and Microanalysis for Real-World Problem Solving
Janet H. Woodward, Buckman
Ke-Bin Low, BASF Corporation
Xiaofeng Zhang, Nanosys Inc.
• Real-world problem solving using all forms of microscopy and microanalysis
• Practical applications of correlative methods employing microscopy and related techniques
• Quantitative approaches for increased confidence in results from non-ideal samples
• Creative methodologies for preparation and analysis of real world samples
• Equipment testing, calibration and quality assurance
A10 Advances in Focused Ion Beam Instrumentation, Applications and Techniques
Suzy Vitale, Carnegie Institution of Washington
Joshua Sugar, Sandia National Laboratories
Bruce Arey, Pacific Northwest National Laboratory
Alan Bahm, Thermo Fisher Scientific
- Beyond Ga: FIB applications using Xe, He, Ne, and development of new ion sources including Cs
- Advances in cryo-FIB and working with beam-sensitive materials
- Advanced circuit edit and in situ device characterization
- Novel geometries, milling strategies and non-standard lift outs for TEM/STEM
- Alternative gas chemistries, etching, and complex structure fabrications
- Enhancing analytical SEM with FIB, including 3D EDS/EBSD or SIMS, and other correlative analytics including WDS, CL, Raman spectroscopy, EBIC, TKD

A11 Current and Emerging Microscopy for Quantum Information Sciences
Miaofang Chi, Oak Ridge National Laboratory
Sonia Conesa-Boj, Delft University of Technology, Netherlands
Lena F. Kourkoutis, Cornell University
- New instrumentation to enable the investigation of quantum materials in S/TEMs
- Current and emerging imaging and spectroscopy techniques for understanding quantum phenomena in materials
- New insights into the behavior of electrons, ions, lattice and spin, and/or their correlations in materials
- Probing spin states and charge transfer in energy and quantum materials
- Qualitative and quantitative analysis of charge distributions in materials
- Development of new, ultra-stable in situ stages for biasing, cooling, and mechanical contact, etc.

A12 Advances in Cryo-EM Technology
Mike Marko, Wadsworth Center
Anchi Cheng, NY Structural Biology Center
Radostin Danev, Tokyo University, Japan
- Sample preparation, including cryo-FIB
- EM instrumentation (cameras, phase plates, automation)
- Image processing for single-particle and tomographic reconstruction
- Applications using cutting-edge technology

Technologists’ Forum Sessions

X30 Utilization of the National NIH funded Cryo-EM Centers: Transformative High Resolution Cryo-Electron Microscopy
CHAIRS: Claudia Lopez, Oregon Health & Science University
Janice G. Pennington, University of Wisconsin-Madison
- Sample preparation “Do’s & Don’ts”
- Best approaches for data collection
- Direct Electron detectors: uses and preferences
- Data processing and handling
- Best practices in a national laboratory
- “Personalities” of different centers

X31 Roundtable: Technical Careers in Microscopy – For the Love of Microscopy
CHAIRS: Phoebe J. Doss, University of Texas Southwestern Medical Center
Janice G. Pennington, University of Wisconsin-Madison
- Technologists from diverse backgrounds in microscopy will speak about their careers.
- How did they find out about microscopy as a career? Why did they choose that instead of all the other options available?
- How has their career developed through the years and what advice do they have for technologists new to the field?
- Learn how to become a Certified Electron Microscopy Technologists (CEMT) and what it can do for you to promote your career.
- Become a part of the conversation and share your story!

X32 Imaging Resin Embedded Samples for Serial Block Face Imaging or Array Tomography
CHAIRS: Janice G. Pennington, University of Wisconsin-Madison
Phoebe J. Doss, University of Texas Southwestern Medical Center
- Array tomography, a technique for imaging serial sections for 3D reconstruction, will be compared with SBFSEM and FIB SEM
- Tips for resin embedding of samples for SEM imaging
- Tips for preparing serial sections for array tomography
- Techniques for correlative light and electron microscopy
PHYSICAL SCIENCES TUTORIALS

X40  Following the Electrons: Simulation for High-Resolution STEM and CBEDs

PRESENTER:
Mark P. Oxley, Oak Ridge National Laboratory

Mark Oxley is a research scientist in the Materials Science and Technology Division at Oak Ridge National Laboratory. His expertise is the simulation and quantification of scanning transmission electron microscopy images and spectroscopy. He is also working on the accurate simulation of 4D STEM data sets to be used as training sets for deep learning algorithms.

- Introduction to basic STEM simulation techniques and the requirement for convergence
- Simulation of electron energy loss spectroscopy for core and low loss excitations
- The importance of including the contribution of electrons that have undergone thermal diffuse scattering
- Convergent beam diffraction patterns: requirements for quantitative simulation

X41  Data Acquisition Schemes, Machine Learning Algorithms, and Open Source Software Development for Electron Microscopy

PRESENTER:
Daniel Masiel, Integrated Dynamic Electron Solutions

Dan founded Integrated Dynamic Electron Solutions (IDES) fresh out of grad school. IDES allows researchers to illuminate nanoscale dynamics with its line of time-resolved imaging products spanning femtosecond to millisecond time scales.

- Instrumentation development and commercialization
- Practical steps to take when starting your own business
- Business start-up best practices
- Financing a scientific instrumentation company

X42  Efficient Phase Contrast Imaging via Electron Ptychography

PRESENTER:
Timothy J. Pennycook, Max Planck Institute for Solid State Research, Germany

Timothy Pennycook is a Scientist at the Max Planck Institute for Solid State Research. His research focuses on developing methods to extract the maximum information out of samples, including using dose efficient 4D STEM methods such as ptychography to see beam sensitive materials more clearly before they are destroyed. He programmed the first implementation of single side band ptychography which has now evolved into ptychoSTEM, a free and open source package for performing ptychography.

- Introduction to ptychography
- Hardware considerations; fast cameras
- Introduction to the free and open source ptychoSTEM package
- Processing the data and performing post collection aberration correction and optical sectioning

BIOLOGICAL SCIENCES TUTORIALS

X43  Expanding the Computational Toolbox for CryoEM

PRESENTER:
Alberto Bartesaghi, Duke University

Alberto Bartesaghi, PhD is currently an Associate Professor of Computer Science, Electrical Engineering and Biochemistry. He pushed the resolution of cryoEM protein structure determination during his tenure as a post-doctoral fellow and staff scientist at the National Cancer Institute in the Sriram Subramaniam lab.

- Robust strategies for particle picking and sorting
- Per-particle frame alignment for high-resolution cryoEM
- Data-driven approaches for optimal exposure weighting
- Unsupervised image sorting using Machine Learning algorithms
- Towards fully automated cryoEM workflows

X44  Electron Optics for CryoEM: Facts and Myths

PRESENTER:
Wim Hagen, The European Molecular Biology Laboratory – Heidelberg, Germany

Wim Hagen is currently the senior engineer in electron microscopy, after working for FEI for many years in multiple roles – building transmission electron microscopes on the factory floor, writing software to control them, and finally as a senior applications cryoEM specialist.

- Electron optics
- Microscope alignment
- Optimizing data collection settings
- Sample quality

X45  Tips and Tricks for High-Pressure Freezing / Freeze Substitution

PRESENTER:
Martin Schauflinger, University of Missouri

Martin Schauflinger, PhD is currently a Senior Research Specialist at University of Missouri’s Electron Microscopy Core. Martin has been refining advanced biological specimen preparative techniques, with his major focus on obtaining optimal contrast of high pressure frozen cellular membranes upon freeze substitution.

- Sample preparation for high pressure freezing
- Sample loading into a high pressure freezer
- Modifying freeze substitution solutions
- Quick freeze substitution
ONSITE AWARDS

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

**MSA Student Poster Awards**

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

**Diatome Poster Awards**

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

**MAS Best Paper Awards**

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

**DISCONTINUED:**

**MSA Micrograph Competition**

The MSA Micrograph Competition at the M&M annual meeting has been replaced by a year-round micrograph contest sponsored by Microscopy Today.

**A NEW MICROGRAPH COMPETITION!**

**Microscopy Today Micrograph Awards**

Scientifically significant micrographs:

- **Published** category (images published in 2018)
- **Open** category (unpublished images)
- **Video** category (movies and 3-D reconstructions)

Submission site will be available in January through the M&M and MSA websites.

**Deadline for submission is February 21, 2019**

Prizes awarded at M&M 2019 in Portland, Oregon!

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**GENERAL CONSIDERATIONS:**

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

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

**STUDENTS:**

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

**POSTDOCTORAL RESEARCHERS:**

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

**PROFESSIONAL TECHNICAL STAFF MEMBERS:**

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

**AMOUNT OF AWARD:**

M&M Meeting Awards and memorial awards consist of full meeting registration and up to $1,000 for travel-related expenses. Original receipts must be provided to receive travel reimbursement.

All award winners also receive an invitation to the Presidents’ Reception, held on the Tuesday evening of the meeting.

**NOTIFICATION OF AWARD:**

All award applicants will be notified of their award status approximately eight weeks following the Call for Papers deadline.

Unsuccessful applicants will be permitted to withdraw their papers, should their ability to attend the meeting be contingent on the award, within one week following notification.

**REQUIREMENTS OF AWARD:**

All award winners must present their paper in person at the M&M meeting in order to receive their award.

Awardees are expected to attend and participate in the entire meeting, which runs from Sunday evening’s opening reception through late Thursday afternoon.

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

X-10 High-Resolution Structure Determination by Cryo-EM: What Could Possibly Go Wrong?
LEAD INSTRUCTORS:
Anchi Cheng, New York Structural Biology Center
Steve Ludtke, Baylor College of Medicine
- Specimen preparation and plunge-freezing choices and considerations
- Data collection – Camera and TEM parameters, TEM automation
- Initial image processing from raw data
- Single-particle reconstruction, choices and validation
- Structure modeling and results presentation

X-11 Super-Resolution Microscopy: Potential, Mechanics, Implementation, and Practicalities
LEAD INSTRUCTORS:
Bryan Millis, Vanderbilt University
Simon Watkins, University of Pittsburgh
- What is “super-resolution microscopy” and do you need it?
- What are the various approaches available and how does each work?
- What are the strengths and weaknesses of each method?
- Practicalities of running super-resolution imaging in a multi-user facility
- How practical is live-cell super-resolution microscopy?
- Common pitfalls of super-resolution microscopy

X-12 Selecting and Optimizing Image Information in the SEM and VPSEM
LEAD INSTRUCTOR:
Brendan Griffin, University of Queensland, Australia
- Understanding the imaging options for materials and biological application-specific SEM use
- Determining specific conditions for the most-relevant sample imaging
- Modern electron detection systems and stage/column variables for SEM/VPSEM
- Tools for measurement and resolution determination

X-13 Modern Electron Crystallography for Materials Sciences and Biology
LEAD INSTRUCTORS:
Sergei Rouvimov, University of Notre Dame
Peter Moeck, Portland State University
- Recent developments in electron crystallography for nanomaterials including soft and biological materials
- Basics of scanning electron diffraction methods for microstructure analysis including bio-crystals
- Electron crystallography applications for structural biology, including protein crystals
- Cryo-electron crystallography, including single-particle cryo-EM
- New experimental and computer-simulation techniques to improve the speed and reliability of structure characterization

X-14 In Situ and Operando Approaches to TEM
LEAD INSTRUCTORS:
Robert Sinclair, Stanford University
Peter Crozier (tentative), Arizona State University
This course will introduce the fundamental concepts for in situ electron microscopy, and will include:
- Hot stages
- Gas cells
- Liquid cells
- Biasing holders
- Magnetic field
- Light illumination

X-15 Data Analysis in Materials Science
INSTRUCTORS:
Duncan Johnstone, University of Cambridge, United Kingdom
Katherine E. MacArthur, Forschungszentrum Jülich, Germany
Magnus Nord, University of Antwerp, Belgium
Francisco de la Peña, University of Lille, France
Eric Prestat, University of Manchester, United Kingdom
Joshua Taillon, National Institute of Standards and Technology
- Introduction to HyperSpy and related Python libraries for multi-dimensional image and spectra processing and analysis
- Machine learning
- Big data analysis strategies
- Curve fitting of multi-dimensional datasets
- EELS and EDS analysis
- Atomic resolution image analysis

Microscopy Outreach Sessions

X91 Microscopy Explorations for Families and Kids of All Ages
Check the M&M 2019 website “Outreach” section under Scientific Program for updated information about this session.

X92 Microscopy Outreach – ProjectMICRO
The Project MICRO workshop is located in the MSA Megabooth all week after the Exhibit Hall opens. Visit the Outreach booth every day to see how to set up different stations in a classroom, and share your experiences with how you have fun with microscopy outreach. See different microscope systems for use in a classroom, in action; peruse the books suitable for elementary school age children; and put your name into a draw for the daily door prize.
2019 Pre-Meeting Congresses

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

Saturday, August 3, 2019 • 8:30 AM – 5:00 PM
Separate registration required.

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

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

PROGRAM CHAIR:
Ethan Lawrence, Arizona State University

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

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

X61 NexTEM: Next-Generation Transmission Electron Microscopy

Sunday, August 4, 2019 • 8:30 AM – 5:00 PM
Separate registration and fee required.

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

ORGANIZERS:
Steven R. Spurgeon, Pacific Northwest National Laboratory
Mitra L. Taheri, Drexel University
Demie Kepaptsoglou, SuperSTEM, United Kingdom

Topics covered within this PMC include:

• Integration of advanced instrumentation, in situ environments, and data analytics tools for more comprehensive characterization of real-world materials
• Emerging instrumentation and approaches to examine nanoscale systems with high spatial resolution and chemical sensitivity
• Novel in situ and operando methods to study the dynamics of complex materials systems, including alloys, thin films, nanoparticles, and liquids
• Machine learning and analytics approaches for high-throughput data collection, processing, and feature classification

Plenary Speakers

The M&M 2019 Executive Program Committee is pleased to present two of the three 2017 Laureates of the Nobel Prize in Chemistry “for developing cryo-electron microscopy for the high-resolution structure determination of biomolecules in solution” and shared with Jacques Dubochet.

Joachim Frank, Ph.D.
Professor of Biochemistry, Molecular Biophysics, and Biological Sciences, Columbia University

Dr. Joachim Frank’s major contribution to the field has been in developing mathematical and computational methods for processing and analyzing cryo-EM images of multiple randomly-oriented molecules within a sample and compiling them into a representative 3D structure. Dr. Frank used his algorithms to generate the first 3D images of the ribosome – a large structure made of several proteins and RNA strands, which is responsible for translating RNA into proteins inside cells in all organisms. With this distinctive technique, when combined with Dubochet’s method of ice-embedding, information on conformational changes of macromolecules in their native states can be obtained, which enables a deeper understanding of the way ‘molecular machines’ function in cells. Structures of many molecules that resist crystalization and hence cannot be studied by X-ray crystallography can now be elucidated. Initially, the resolution that could be obtained was limited by the poor performance of recording media. This technical problem was solved 7 years ago with the introduction of cameras capable of detecting single electrons. The development of cryo-electron microscopy has revolutionized the imaging of biomolecules and propelled biochemistry into a new era. By now, about 1500 structures of proteins and RNA-protein complexes have been solved and entered in a public database, making this knowledge a fast growing and increasingly important contribution to molecular medicine and the development of drug therapies.

Dr. Frank’s achievements were recognized with MSA’s Distinguished Biological Scientist award in 2003, and he was named an MSA Fellow in 2009.

Richard Henderson, Ph.D.
Medical Research Council Laboratory of Molecular Biology (MRC LMB) – Cambridge, United Kingdom

Single Particle CryoEM: Potential for Further Improvement

Dr. Richard Henderson developed TEM into a tool for the direct determination of the structure of proteins, and applied it most notably to two-dimensional (2D) crystals of the purple light-harvesting protein, bacteriorhodopsin. Images and electron diffraction patterns of many 2D crystals of bacteriorhodopsin from multiple angles were acquired using low-dose electron exposures, and combined to generate a 3D image of the protein. He continued to refine this technique over many years until he produced images at similar resolutions as those from X-ray diffraction. Later, Dr. Henderson turned his attention to the development and improvement of methods of high-resolution electron cryo-microscopy and single particle structure determination. With colleagues, he advanced these techniques for exploring high resolution ultrastructure of membrane proteins, protein complexes and other non-crystalline biomolecules in solution. During this journey, Dr. Henderson made critical contributions to many of the single particle electron microscopy approaches, including pioneering the development of direct electron detectors.

Dr. Richard Henderson was presented with MSA’s Distinguished Biological Scientist award in 2005, and was named as an MSA Fellow in 2009.

Kyun Seong Dae • Korea Advanced Institute of Science and Technology • NANOLEDG
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