Minnesota Microscopy Society

Local affiliate of the ***Microscopy Society of America***
and the ***Microanalysis Society***

Newsletter *April 2015*

Minnesota Microscopy Society Spring Symposium

Date: Friday, May 1, 2015

Location: Science Museum of Minnesota
120 W. Kellogg Blvd., St. Paul
Discovery Hall

Parking: Science Museum or River Centre parking ramps

Schedule

7:30 – 8:15 AM	Registration, Continental Breakfast, Vendor Displays
8:15 – 8:30 AM	Welcome
8:30 – 9:30 AM	**David Flannigan** *Ultrafast Electron Microscopy: Operating Principles and Parameter Space*
9:30 – 10:30 AM	**Mark Kelsey** *Tomography: What You See Depends on How Deep You Go*
10:30 – 11:00 AM	Break and Vendor Displays
11:00 – 12:00 PM	**David Cullen** *The Role of Aberration-corrected Electron Microscopy and Microanalysis in Developing Energy-related Materials*
12:00 – 1:30 PM	Lunch and Vendor Displays
1:30 – 1:45 PM	Business Meeting
1:45 – 2:45 PM	**Alison North** *Optimizing Oils, Otfs and the OMX: A Tale of Two Rabbit Ears*
2:45 – 3:45 PM	**Brian Castle** *Cellular Polymer Tracking Using Digital Fluorescence Microscopy: Probing the Spatial and Temporal Limits*

Spring Symposium

continued

Registration

The cost of the meeting will be $75 for MMS members, $85 for nonmembers, and $20 for students/K-12 teachers via PayPal at the link below. The fee includes the meeting, buffet lunch, breakfast, coffee breaks and a free pass to the Museum exhibits.

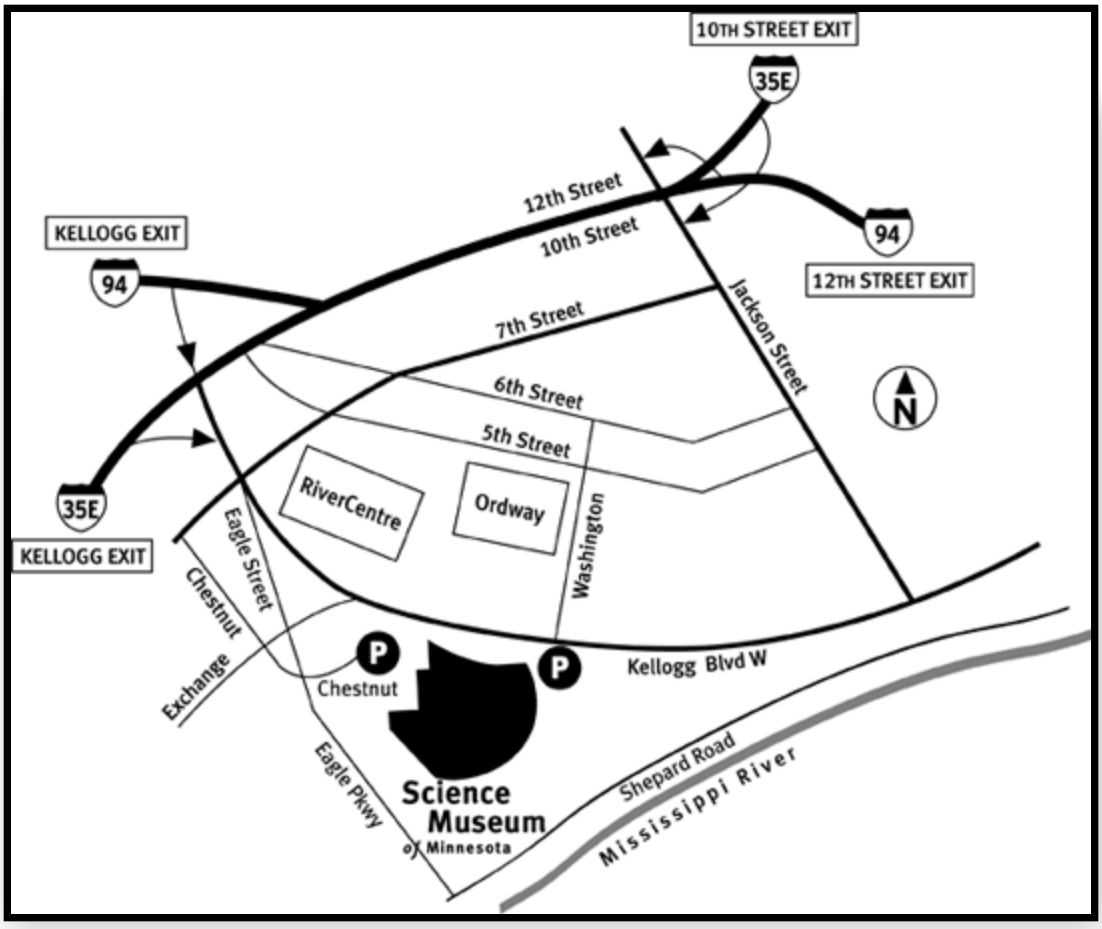
Reservations must be made no later than April 24th.

Register online at **http://www.mnmicroscopy.org/calendar.html.** Or call the Treasurer at 763-533-0649.

Directions

The Science Museum's parking ramp can be accessed from either Kellogg Blvd or Chestnut St. Enter museum by taking parking ramp elevator to the Lobby level. The River Centre ramp is an alternative to the Science Museum ramp.

The meeting will be held in Discovery Hall. If entering the museum from Kellogg Boulevard, go through the Lobby, angle left just after the box office and continue to the stairs/elevators. The Discovery Hall is one floor down.



Spring Symposium 2015 - Speakers

Ultrafast Electron Microscopy: Operating Principles and Parameter Space

David Flannigan, Ph.D., Assistant Professor
Dept. of Chemical Engineering and Materials Science
University of Minnesota

Biography

Dr. David J. Flannigan earned his B.S. in chemistry with a minor in mathematics at the University of Minnesota in 2001. Under the mentorship of Prof. Wayne L. Gladfelter, he conducted research on the synthesis of anhydrous metal nitrates as volatile, single-source precursors for the CVD of carbon-free thin metal oxide films. He earned his Ph.D. in chemistry at the University of Illinois at Urbana-Champaign in 2006 with Prof. Kenneth S. Suslick, where he studied the physical conditions and chemical processes occurring during single-bubble acoustic cavitation in aqueous mineral acid solutions. From 2007 to 2012, he was a Postdoctoral Associate and then a Senior Postdoctoral Associate in the labs of Prof. Ahmed H. Zewail at Caltech. There, his research focused on the development and application of ultrafast electron microscopy. He is currently a *McKnight Land-Grant* Professor and the *Ray D. and Mary T. Johnson/Mayon Plastics* Assistant Professor of Chemical Engineering and Materials Science at the University of Minnesota. His research interests are in the development and advancement of ultrafast electron microscopy and its application to a wide range of chemical and materials problems and phenomena.

Abstract

The last 100 years was a time of great progress in static structure determination and atomic-scale visualization of materials via X-ray and electron-based techniques. While undeniably powerful, knowing the structure reveals only part of the overall story. What is missing is direct determination of how all components of the system behave while traversing the potential energy surface. Ultrafast electron microscopy (UEM) provides access to the spatiotemporal scales required to directly probe atomic to microscale structural dynamics in real-time (*i.e.*, with up to femtosecond temporal resolution). By combining a transmission electron microscope with pulsed lasers, one may directly obtain structural, electronic, and magnetic information for transient states via time-resolved (fast and ultrafast) imaging, diffraction, and spectroscopy. In this talk, I will discuss the fundamental operating principles of UEM. I will provide details on approaches to single-shot and stroboscopic measurements, wherein access to irreversible and reversible processes are gained, respectively. Importantly, the current resolutions will be defined, and the efforts being undertaken to advance the frontiers of both UEM spatial and temporal resolutions will be described. This will lead naturally into a discussion of the parameter space that currently can be explored with UEM, and will illuminate the wide variety of materials systems that can be studied.

cont'd…

Spring Symposium 2015 - Speakers

DAVID FLANNIGAN *cont'd...*

During the latter part of the talk, I will share details on the hardware and laboratory configuration of the UEM lab at the University of Minnesota. This will include specifics on the layout of the laser systems, interfacing of said systems to the transmission electron microscope, and implementation of strict environmental controls for increasing sensitivity and stability. The goal is to provide a clear picture of the types of measurements that can be done with UEM such that opportunities for interfacing with computation and modeling can be identified.

Tomography: What You See Depends on How Deep You Go

Mark Kelsey, Senior Sales Engineer
Bruker Nano, Inc.

Biography

Mark Kelsey has a B.S. in chemistry from St. Louis University and an M.S. in analytical chemistry from Purdue University. He has been working in the field of materials characterization since 1974. Currently, he is a Senior Sales Engineer for Bruker and has been working in the field of microanalysis since 2001.

Abstract

When electrons from a scanning electron microscope (SEM) strike and penetrate a sample, different information can be revealed. Closest to the surface, the secondary electrons (S1 and S2) produce a 2D from a depth of 5-10 nm. From a depth of .25-1 µ, comes the 2D backscatter image. Most of the chemical information comes from deeper in the sample as the electrons continue their interactions and produce X-rays characteristic of the elements present.

The information, though, is limited by the depth that the electrons can penetrate. To go deeper into the sample, the electrons must be replaced with (or converted to) X-rays. X-rays not only penetrate deeper into a sample, but in some cases can be transmitted through the sample. For these cases, a 2D image can be captured on a camera. If the sample is rotated, then a series of the 2D images can be collected and combined with a computer to produce a full 3D image of the sample. This volume imaging is called computed tomography (CT). This talk will show how the SEM can be used to produce the X-rays and images and present some examples.

Spring Symposium 2015 - Speakers

The Role of Aberration-Corrected Electron Microscopy and Microanalysis in Developing Energy-Related Materials

David A. Cullen, Ph.D., Research Staff
Materials Science and Technology Division
Center for Nanophase Materials Sciences
Oak Ridge National Laboratory (ORNL)

Biography

Dr. David Cullen began his professional career in 2010 as an *Alvin M. Weinberg Fellow* at Oak Ridge National Laboratory. Now a research staff member in the Electron Microscopy Group, his research involves the application of aberration-corrected and analytical scanning transmission electron microscopy to the field of applied catalysis, with a significant emphasis on polymer electrolyte membrane fuel cells. He holds a Ph.D. in materials science and engineering from Arizona State University, and a Bachelor of Science in applied physics from Brigham Young University. Thanks to numerous collaborations with industry, academia, and other national laboratories, he has published extensively, receiving recognition for such as the recipient of the 2013 Appalachian Regional Microscopy Society Young Investigator Award.

Abstract

In a time when the growing demand for energy is coupled with increasing pressure to develop and implement clean and renewable energy technologies, the need for advanced characterization tools is greater than ever. The field of electron microscopy has undergone a revolution over the last two decades with the advent and wide-spread implementation of aberration-corrected microscopy, pushing the resolution of these complex instruments to the sub-Angstrom scale. The increase in resolving power has been followed by advancements in energy dispersive X-ray spectrometers and *in situ/in operando* microscopy, leading to a powerful complement of tools for advancing energy-related research. This talk will highlight the impact of ongoing microscopy research at Oak Ridge National Laboratory on a broad range of energy-related materials, from fuel cell catalysts to graphene.

Spring Symposium 2015 - Speakers

Optimizing Oils, Otfs and the OMX: A Tale of Two Rabbit Ears

Alison North, Ph.D., Research Associate Professor
The Rockefeller University
and Senior Director, Bio-Imaging Resource Center

Biography

Dr. Alison North has directed the Bio-Imaging Resource Center at The Rockefeller University in New York since April 2000, when it was first established. An undergraduate of the University of Cambridge, she received her doctorate from Oxford University, using immunoelectron microscopy to study the muscle defects caused by Duchenne muscular dystrophy. Her first postdoctoral research position was undertaken in Salzburg, Austria, performing immunoelectron microscopy studies of the smooth muscle cytoskeleton, and her second in Manchester UK, researching desmosome organization. A Wellcome Trust Career Development fellowship enabled her to follow this up with studies of the dynamics and assembly of desmosomes, which is when she became hooked on GFP and live cell imaging. She now advises and trains hundreds of Rockefeller University and external researchers in a wide variety of optical microscopy techniques.

Abstract

Super-resolution microscopy describes a collection of optical microscopy techniques that employ various methods to circumvent the conventional diffraction barrier. These imaging modalities are still relatively new and significant work remains to be done to ratify their appropriate use. The achievable resolution with each method is generally described for sub-resolution multi-colored fluorescent beads, but such resolutions are rarely applicable to biological samples.

This presentation will examine the application of two super-resolution microscopy methods, 3D-Structured Illumination Microscopy (3D-SIM) and Stochastic Optical Reconstruction Microscopy (STORM) to different types of biological specimens. The optimization of each technique will be discussed, together with common aberrations and associated problems. Since the image quality and effective resolution obtained are often limited by both imperfect system alignment and sub-optimal sample preparation, we are attempting to define standardized specimen preparation protocols and strict testing regimes for each microscope using samples of known dimensions. In 3D-SIM, the changing refractive index with increasing sample depth remains a significant problem and the 2D bead slides do not closely mimic most biological samples. We have therefore designed 3D test samples of multi-spectral beads in two types of gel to assess the reliability of the data at different depths and to optimize the combination of Optical Transfer Functions (OTFs) used to reconstruct the data. Datasets obtained from such 3D bead samples can reveal significant system alignment problems and also enable us to judge the reliability of subsequent experimental datasets. Further standardized samples for testing the achievable resolution on our OMX and STORM systems will additionally be presented.

Spring Symposium 2015 - Speakers

Cellular Polymer Tracking using Digital Fluorescence Microscopy: Probing the Spatial and Temporal Limits

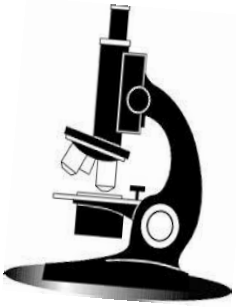
Brian Castle, Ph.D., Postdoctoral Fellow
Department of Biomedical Engineering
University of Minnesota

Biography

Dr. Brian Castle is a Postdoctoral Associate in the Department of Biomedical Engineering at the University of Minnesota. Brian currently works in Professor David J. Odde's lab, where his research focuses on combining quantitative fluorescence microscopy with computational modeling to better understand the dynamics of cellular polymer self-assembly.

Abstract

The self-assembly dynamics of microtubules, an abundant cellular polymer, serve essential functions in processes such as mitosis and intracellular transport. Due to size (~25nm diameter) and rapid dynamics (~100-500Hz), quantitative imaging of microtubule assembly requires both high spatial and temporal resolution. Using digital fluorescence microscopy, increased spatial or temporal resolution generally requires a sacrifice of one for the other, such that the optimal imaging parameters will depend upon the specific application. Here I will present an approach to tracking microtubule self-assembly dynamics with high spatial and temporal resolution (10-40nm at 10Hz) using widefield fluorescence microscopy, as well as discuss the application-specific limitations in spatial and temporal resolution.



November 7

What: **Microscope Day**

Time: 12:00 – 4:00 pm

Location: Science Museum of Minnesota
St. Paul, MN

Anyone interested in volunteering, please contact Ann Palmer: palme003@umn.edu

Election of MMS officers for 2015/2016 to be conducted during the business meeting following lunch.

Candidates proposed by the board:

President Elect – Dave Burleson

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** Nominations will be accepted from the floor.*

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Minnesota Microscopy Society – Membership Form

All microscopists are urged to support their Society at one of the membership levels offered below. Often, supervisors will support MMS memberships out of their project budget because they recognize that it is a very inexpensive way to maintain and increase the skills of their microscopists. If you have been a member over the years and recognize the value of MMS to the community of microscopists it serves, consider upgrading your membership this year to the patron or sustaining level. Thank you.

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