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M<sup>3</sup>S hosts M<sup>3</sup>B:

# Microscopy & Microanalysis for Materials and Biology

Friday 30<sup>th</sup> April 2010

The Midwest Microscopy and Microanalysis Society will host a day-long meeting on Friday, April 30<sup>th</sup>, on the campus of the University of Wisconsin, Madison. There will be a morning plenary session, then parallel afternoon sessions for physical sciences and biological sciences. Registration is free for M3S members, \$20 for non-members and \$5 for student non-members (this includes membership of M3S for 2010).

If you are planning to attend please RSVP to Alan Nicholls ([nicholls@uic.edu](mailto:nicholls@uic.edu)) remembering to indicate your box lunch preference by April 26<sup>th</sup> (please see last page for choices).

Paul Voyles ([voyles@engr.wisc.edu](mailto:voyles@engr.wisc.edu)) is the program organizer.

Exhibitors at M<sup>3</sup>B will include Edax, Thermo Scientific, Oxford Instruments, Southbay Tech, JEOL, Zeiss, Buehler, and FEI. Jon McCarthy ([jjmccarthy@wisc.edu](mailto:jjmccarthy@wisc.edu)) is the exhibit organizer.

## Schedule

### Plenary Session

9:00-9:45: **K. Andre Mkhoyan**, Department of Chemical Engineering and Materials Science, University of Minnesota

#### **Understanding Carbon Nanotube Growth using Atomic-Scale (S)TEM**

Many of unique properties of carbon nanotubes (CNT) are highly sensitive to arrangement of carbon atoms within the graphene nanotube wall(s) and, therefore, precise structural control of this arrangement remains the key challenge of CNT growth and realization their technological potential. Application of convergent beam electron diffraction, high-resolution bright field and composition-sensitive annular dark field imaging, energy dispersive x-ray spectroscopy, and electron energy loss spectroscopy in atomic-

resolution scanning transmission electron microscopy ((S)TEM) allowed careful investigation of the fundamental processes of CNT growth from typical Fe/Fe<sub>3</sub>C catalytic particles.

9:45-10:30: **Huifang Xu**, Department of Geoscience, and Materials Science Program ,  
University of Wisconsin –Madison

**Application of TEM & associated techniques in earth and environmental materials studies**

A new generation of transmission electron microscope / scanning electron microscope and associated techniques of spectroscopy and chemical imaging can help us to better understand materials' structures, chemistry, and interfaces at the atomic scale. Examples of materials for water splitting through piezoelectrochemical effect, photocatalytic decomposition of organic pollutants, nuclear waste / pollutant immobilization, and carbon dioxide sequestration will be presented. TEM / STEM results from natural soils and rocks will also be demonstrated.

10:30-10:45: **Coffee break**

10:45-11:30: **Ralph Albrecht**, Department of Animal Sciences& Division of Pharmaceutical Sciences, University of Wisconsin, Madison

**Nanoparticles of Differing Shapes and Compositions as Labels for Co-Localization at High Spatial Resolution**

Fluorescence light microscopy uses dyes with differing excitation and emission wavelengths to provide labels that can be viewed simultaneously to determine the spatial relationships between multiple labeled species at resolution levels possible with photon based optics. Electron microscopy can readily resolve individual molecules but as of yet there is no good way to do multiple simultaneous labeling at molecular and sub-molecular levels of resolution. Here we explore the use of nanoparticles of similar size but having different shapes and/or different elemental compositions to facilitate simultaneous multiple labeling at the levels of spatial resolution attainable with electron based optics.

11:30-12:15: **Dilano K. Saldin**, Department of Physics, University of Wisconsin, Milwaukee

**Crystallography without Crystals: Breaking the Crystallization Paradigm**

We propose a method for structure determination of uncrystallized proteins, by directly recovering the diffraction pattern of a single molecule from that of multiple randomly positioned and randomly oriented ones through their correlated scattering, and subsequent iterative phasing of this diffraction pattern to recover the molecular electron density. We suggest a possible application to structure determinations of membrane proteins *in situ*. Potential applications for the proposed single-molecule XFEL experiments will also be discussed, as well as ideas for extracting time-resolved information.

12:15-1:30: **Lunch and Exhibit**. Boxed lunch will be provided with registration.

## Afternoon Physical Sciences

1:30-2:00 **Song Jin**, Department of Chemistry, University of Wisconsin, Madison

### **Dislocation-Driven Nanomaterial Growth: Nanowire Trees, Nanotubes, and Beyond**

I will discuss a nanowire formation mechanism in which axial screw dislocations provide the self-perpetuating steps to enable 1-dimensional (1D) crystal growth, unlike previously understood vapor-liquid-solid (VLS) mechanisms that require metal catalysts. This mechanism was initially found in hierarchical nanostructures of lead sulfide (PbS) nanowires with helically rotating branches resembling “pine trees”. I will further explain how dislocations result in the spontaneous formation of nanotubes. Dislocation-driven growth should be general to many materials grown in vapor or solution phase and is underappreciated in modern nanomaterial literature. Our discoveries will create a new dimension in the rational design and synthesis of nanomaterials.

2:00-2:30 **Paul Evans**, Department of Materials Science and Engineering, University of Wisconsin, Madison

### **Molecule-scale imaging of organic semiconductors**

Organic semiconductors have tremendous promise in a wide range of applications in electronics, energy, and sensing. Structural defects in thin films of small-molecule semiconductors dramatically affect electronic properties, including the mobility of charge carriers. Scanning tunneling microscopy allows us to probe these defects, describe their molecular structure, and understand their origin.

2:30-2:45: **Coffee break**

2:45-3:15 **Scott Walck**, South Bay Technology Inc.

### **Low Energy, Low Angle, Large Area Ion Polishing for Improved EBSD Indexing**

Good sample preparation is essential for acquiring successful electron backscattered diffraction (EBSD) patterns in the SEM. This paper discusses the use of a low energy, Kaufman ion source coupled to an SBT IBS/e system to significantly and reproducibly improve the sub-surface quality of samples that are difficult to prepare by mechanically polishing. Pattern quality factors were used from EBSD maps to quantify the improvement in sample preparation of copper and Ti-6Al-4V samples by comparing the statistical distributions from the maps acquired before and after ion processing.

3:15-3:45 **Vahid Firouzdor**, Department of Materials Science and Engineering, University of Wisconsin, Madison

### **Formation of Intermetallics in Friction Stir Welding of Aluminum to Magnesium**

The formation of intermetallic compounds in Al-to-Mg FSW was investigated in friction stir welding (FSW) of the Al and Mg. The presence of intermetallic compounds can significantly weaken the joint strength. The intermetallic compounds in the stir zone were revealed by color etching and optical microscopy and identified by XRD, EPMA and TEM as  $Al_3Mg_2$  and  $Al_{12}Mg_{17}$ . Formation of the intermetallic compounds can be due to constitutional liquation.

3:45-4:15 **Bill Stratton** 3M Inc

**Electron Microscopy Software at the 3M Corporate Research Analytical Laboratory**

At the 3M Corporate Research Analytical Laboratory we use a wide range of techniques to answer various product and research questions. I will present new particle/grain sizing software and EELS database software currently being developed in the electron microscopy group.

4:15: **Ice cream and Exhibit.** Optional tour of UW Materials Science Center characterization facility, including the new aberration-corrected FEI Titan (S)TEM.

## Afternoon Biological Sciences:

1:30-2:00: **Marisa Otegui**, Department of Botany, University of Wisconsin, Madison

### **Dissecting membrane trafficking pathways in plants by electron tomography**

Plant cells exhibit highly dynamic protein and membrane trafficking pathways. Of particular interest are the endosperm cells in cereal seeds, which synthesize and accumulate important amount of storage proteins in a brief period of time. We have used electron tomography of plastic sections, immunolabeling of high-pressure frozen/freeze substituted samples, and living confocal imaging to study the trafficking of prolamin storage proteins in two cell types of the maize endosperm. We have found that whereas prolamins are stored inside the endoplasmic reticulum in starchy endosperm cells, the same protein are incorporated to vacuoles *via* autophagic mechanisms in the endosperm epidermis (also called aleurone layer). These results are not only important for understanding the protein trafficking pathways that operate in plants but also, in the design of transgenic cereal seeds with better nutritional features.

2:00-2:30 **Ian Rowland**, Department of Radiology, University of Wisconsin, Madison

### **3D-MR Microscopy at 4.7T**

Using standard hardware, 3D images may be acquired from specimens with an isotropic resolution of less than 50  $\mu\text{m}$ . Since the data is 3D, it may be re-sliced in any direction or used to obtain volumetric data via segmentation. MR contrast agents may also be used to enhance the relaxation of the specimen enabling faster image acquisition or higher resolution. Examples will be presented that illustrate the detail available in fixed specimens, with and without contrast agent, together with recent results using a tissue specific MR stain.

2:30-2:45 **Coffee break**

2:45-3:15 **Jeff Lengyel**, FEI Co.

### **Advances in Electron Microscopy in Biological Applications**

Recent advances in electron microscopy technology are allowing for many exciting discoveries in biomedical research. For instance, cryo-electron microscopy is now capable of generating three-dimensional reconstructions of viruses at atomic resolution. The use of Dualbeam™ technology is able generate large three-dimensional volumes of cells and tissues at molecular resolution, allowing for novel understanding of cellular architecture. Also, STEM tomography is proving to be a useful method for the three-dimensional imaging of thick biological resin embedded sections that could not easily be studied with traditional TEM tomography.

3:15-3:45 **Jeniell Nett**, Department of Medicine Division of Infectious Disease, University of Wisconsin, Madison.

### **Imaging of Fungal Biofilms on Medical Devices**

The fungal pathogen *Candida* causes disease by growing as a biofilm on the surface of medical devices. We used scanning electron microscopy and confocal microscopy to image *Candida* biofilms infecting venous catheters and oral devices in animal models.

3:45-4:15 **Ameesha Shetty**, Department of Soil Science & Molecular and Environmental Toxicology Center, University of Wisconsin, Madison

**Nanopods: Characterization of a novel bacterial surface (S) layer protein and extracellular structure**

The phenanthrene-degrading bacterium *Delftia* sp. Cs1-4 produces a new S-layer protein, which is essential for the formation of novel extracellular, tubular structures we have termed “nanopods”. In this work we’ll present information regarding the structure of this element, as well as potential function(s) of the S-layer protein and nanopods.

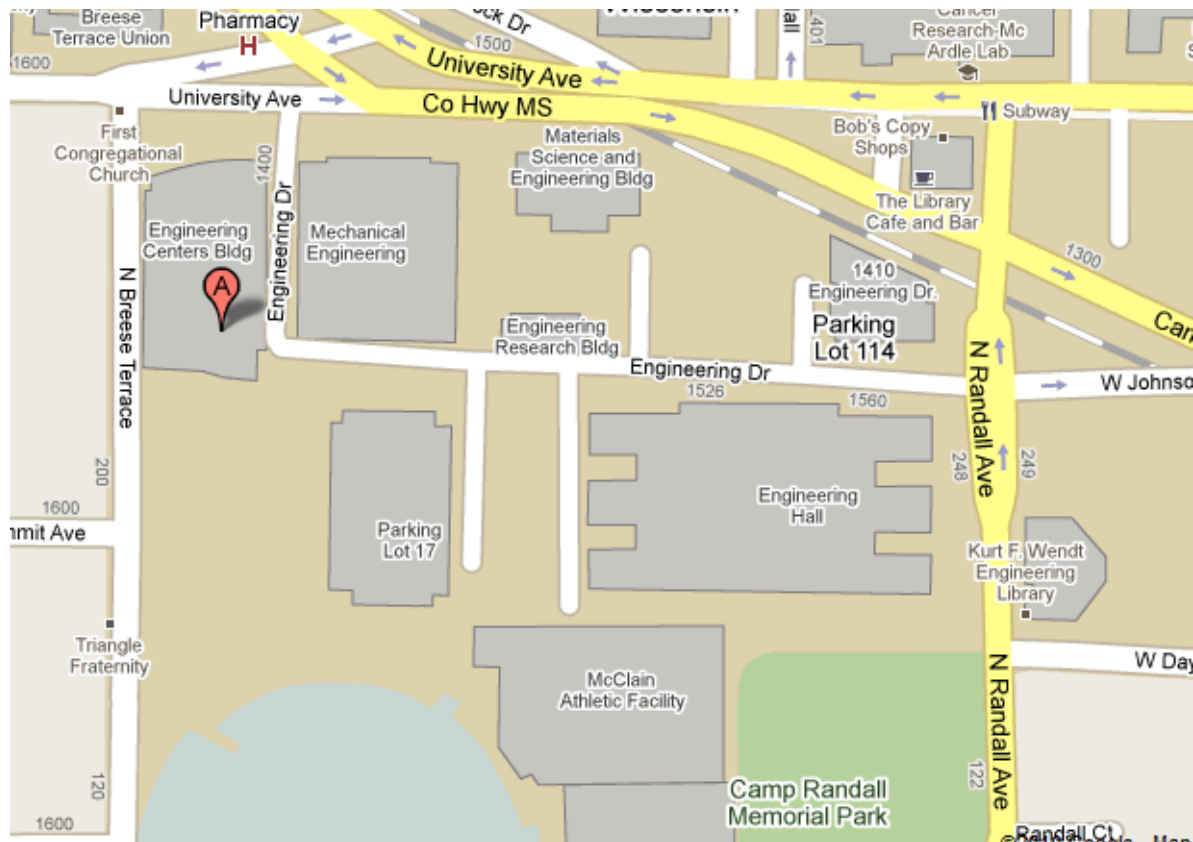
4:15: **Ice cream and Exhibit.** Optional tour of UW Materials Science Center characterization facility, including the new aberration-corrected FEI Titan (S)TEM.

## Conference Site

M3B will be held in the UW Engineer Centers Building, 1550 Engineering Drive, Madison WI. The morning session will be in Rm 1025. The afternoon sessions will be in Rm 1025 (physical sciences) and 1045 (biological sciences). Registration will be set up in the hall outside.

Parking is available in university parking lot 17, which is a multilevel parking garage. Enter from Engineering Drive. A single-day pass is \$12.

A campus map is on the web at <http://www.map.wisc.edu/>.



## **M<sup>3</sup>B RSVP**

Registration for M<sup>3</sup>B is free for M3S members, \$20 for non members (\$5 for student non-members) and includes lunch, thanks to the support of our vendors. Please RSVP to Alan Nicholls, nicholls@uic.edu. making sure to indicate your sandwich preference (Beef, Veggie, Chicken or None).

There will be three types of sandwich box sandwich lunches available.

- 1) Roast Beef
- 2) Veggie Wrap
- 3) Chicken Breast

A fresh fruit side dish and a brownie are included with each lunch. Please also let us know if you have any other food requirements or allergies. We will do our best to accommodate your needs.