Michigan Microscopy & Microanalysis Society

2013 Conference

Midland, MI

Held at

The Dow Chemical Company

Analytical Sciences Department

October 18, 2013

Program Guide

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Conference Arrangements

Clifford Todd
Michael Behr
The Dow Chemical Company

Michigan Microscopy & Microanalysis Society conference

Talk Schedule, October 18, 2013

Time	Name	Affiliation	Dept	Title
9:00 - 9:10	Todd, Clifford	Dow Chemical	Analytical Sciences	Opening remarks
9:10 - 9:55	Arslan, Ilke	Pacific Northwest National Labs	Physical Sciences Division	3-D and In-situ Characterization of Nanomaterials in the Scanning Transmission Electron Microscope
9:55 - 10:10	Williams, David	Dow Chemical	Analytical Sciences	Microscopy Method to Show Reduced Oil Uptake in Fried Foods
10:10 - 10:25	Nemala, Humeshkar	Wayne State University	Dept of Physics and Astronomy	Behavior of magnetic nanoparticles in an AC magnetic field: Relevance of constraints placed by microscopy and magnetic measurements
10:25 - 10:35	Break			
10:35 - 10:50	Nazri, Gholam-Abbas	Frontier Applied Sciences & Technologies, LLC		Advance 3-D conformal Silicon/Carbon Nanofiber-Graphene Composites for Next Generation of Li Batteries
10:50 - 11:05	Lin, Jui-Ching (Phillip)	Dow Chemical	Analytical Sciences	Investigation of the growth of intermetallic compounds between Cu pillars and solder cap
11:05 - 11:35	Brock, Stephanie	Wayne State University	Dept of Chemistry	Structure, Morphology, and Phase Transitions in Metal Pnictide Nanomaterials as Probed by Transmission Electron Microscopy
11:35 - 2:00	Lunch, Vendors, Posters, Lab Tours*			
2:00 - 2:45	Price, Bob	Univ South Carolina	School of Medicine	Some Aspects of Imaging in Colon Cancer Research
2:45 - 3:00	Palyvoda, Olena	Wayne State University	Electrical and Computer Engineering	Raman Spectroscopy Applications in Biomedicine
3:00 - 3:10	Break			
3:10 - 3:25	Vincent, Kailey	Central Michigan University	Biology Dept	Germ granule localization and multivesicular body quantitation during late gastrulation in Penaeus japonicus
3:25 - 3:40	Gunther, Laura	Wayne State University	Dept of Physics and Astronomy	Two Myosin 5c Molecules on a DNA Scaffold Steps processively along Actin
3:40 - 3:55	Heckman, Carol	Bowling Green State Univ	Biology Dept	Regulation of cell protrusions by protein kinase C (PKC)
3:55 - 4:05	Kimler, Victoria	Wayne State University	School of Medicine	Awards, Closing
4:05 - 5:00	Kimler, Victoria	Wayne State University	School of Medicine	MMMS Business Meeting

*There will be opportunities to tour the microscopy labs in Dow Chemical's Analytical Sciences from 11:35 – 2:00 and from 4:00 – 5:00. If you want to participate, pants and impermeable closed-toed shoes (not mesh or canvas) are required. Safety glasses and lab coats will be provided.

Michigan Microscopy & Microanalysis Society conference

Posters, October 18, 2013

Name	Affiliation	Dept	title
Bazzi, Khadije	Wayne State University	Dept of Physics and Astronomy	Effect of Li Rich on Electrochemical Behavior of LiFePO4 Cathode Material for Li ion Battery
Garnett, Matt	Central Michigan University	Earth and Atmospheric Sciences	Investigating Cataclastic Contact Boundaries at Trachyte Mesa, Henry Mountains, Utah, USA
Mukherjee, Rupam	Wayne State University	Dept of Physics and Astronomy	Quantitative analysis of percolating cluster using SEM/EDX spectrometer in binary composite system
Laha, Suvra	Wayne State University	Dept of Physics and Astronomy	Synthesis and characterization of boron stabilized Mn3O4 nanoparticles
Dhindsa, Kulwinder	Wayne State University	Dept of Physics and Astronomy	Enhanced electrochemical performance of graphene modified LiFePO4 as a cathode material for lithium ion batteries
Mei, Yuwen	Wayne State University	Dept of Physics and Astronomy	Three dimensional (3-D) vesicle trafficking using super resolution microscopy
Abdelhamid, Ehab	Wayne State University	Dept of Physics and Astronomy	UV-induced stable photoconductivity in Indium Oxide films
Karasiewicz, Kristen	Central Michigan University	Biology Dept	Vasa and Nanos Protein Localization in the Germ Line in Penaeid Shrimp
Trombley, Alicia	Central Michigan University	Biology Dept	Presence of RNP Granules and Nuclear Membrane Blebs in Caenorhabditis elegans cgh-1 mutants
DeSantis, Daniel	Central Michigan University	Biology Dept	Cell Differentiation in Corn Endosperm
Calloway, Lucas	Central Michigan University	Biology Dept	Binding Efficiency of Environmental Escherichia coli to Sediment Particles Compared to Human Intestine Isolates
Price, Janet	Central Michigan University	Biology Dept	Investigating the Membrane-Binding Activity and Localization of Copine Proteins in Dictyostelium
Varghese, Mita	Wayne State University	Center for Integrative Metabolic and Endocrine Research	Sharing fat: Lipid droplet interactions with organelles in brown adipose tissue

Posters will be up 9 AM – 4 PM
Authors will be at their posters 12:45 PM – 2:00 PM

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Michigan Microscopy & Microanalysis Society Conference
Speaker List, October 18, 2013

9:10 AM

Ilke Arslan (invited)

Physical Sciences Division, Pacific Northwest National Labs, Richland, WA

3-D and In-situ Characterization of Nanomaterials in the Scanning Transmission Electron Microscope

All nanomaterials are three-dimensional (3-D) in nature whether they are used for catalysis, energy storage, semiconductors, or medicine. While (scanning) transmission electron microscopes ((S)TEMs) are typically used to analyze these materials, the images are 2-D projections of 3-D objects. In order to understand the true nature of the nanomaterial, a 3-D tomogram is necessary on the nano- or atomic scale. Traditionally, this involves taking a series of images of the sample at different tilt angles, normally ranging between -70° to +70° every 1 to 2 degrees, and using these two dimensional images to reconstruct a three dimensional volume of the sample. This tilt range may increase depending on the sample geometry and the holder used, but there is a constant battle against an artifact in the reconstruction called the missing wedge. This effect may be reduced greatly by performing dual axis tomography, or overcome completely using new holder technologies, but each technique has its pros and cons. Another approach that has been taken in the last 3-5 years is the development of novel algorithms that greatly reduce the effects of the missing wedge and even provide atomic resolution 3-D tomograms from just a few projection images.

With recent advances in in-situ microscopy, a new era in microscopy has arrived that allows for the dynamic imaging of materials under reaction conditions. It is no longer sufficient to image materials in vacuum conditions, but to get closer to the conditions in which the material will be used, such as high temperature, liquid environments, gas environments or a combination thereof. Combining an in-situ or ex-situ experiment with STEM tomography is a very powerful method for materials characterization. The benefits and limitations of all these methods will be discussed through examples of different inorganic materials.

9:55 AM

David M. Williams[1], Jing Guo[2] and Robert Fletcher[2]

1. Analytical Sciences, The Dow Chemical Company, Midland, MI
2. Food & Nutrition R&D, The Dow Chemical Company, Midland, MI

Microscopy Method for Characterization of Oil Uptake in Fried Foods

The Dow Chemical Company is an industry leader in providing state-of-the-art products and technical service to the food industry. A microscopy method was needed to help evaluate the efficacy of WELLENCE™ Fat Reduction based batter coating formulations to inhibit oil uptake in french fries during cooking.

Osmium tetroxide and Oil Red O staining methods were adapted. Optical microscopy demonstrated these methods successfully stained cooking oil in cross sections of uncoated and WELLENCE Fat Reduction batter coated french fries. Sections measuring approximately 4-5 mm thick of the cooked uncoated and coated french fries were paced in 1% aqueous osmium tetroxide for 5-minutes then rinsed in running tap water for 20-minutes. Additional sections were stained in 0.5% Oil Red O (in propylene glycol) for 30-minutes, differentiated in 85% propylene glycol and then rinsed in water. All stained sections were submerged in DI water in a small petri dish and imaged using coaxial illumination. Each sample was then mounted on sample stubs using a cyanoacrylate adhesive and sectioned 150 um-250 um thick using a Series 1000 Vibratome vibrating microtome. The Vibratome sample trough was filled with distilled water to facilitate the sectioning and easy removal of the cut sections. The cut sections were mounted on glass slides and imaged.

Using optical microscopy it was observed that osmium stained the cooking oil black as well as lightly staining the potato cell membranes of the uncoated sample. The Oil Red O stained the cooking oil reddish orange. The potato itself was not stained by oil Red O and remained white in color. Both stains showed a clear distribution of the cooking oil. The uncoated samples displayed significantly more oil staining throughout the french fry cross sections. Osmium staining also showed significant cellular damage from the loss of moisture within the french fry and it's replacement with oil. Very little penetration of the cooking oil into the interior of the coated french fries was observed. The hypothesis is that WELLENCE Fat Reduction in the batter formulation thermo-gels and forms a protective barrier keeping oil from penetrating the french fries. Supporting the microscopy results is a quantitative analysis of the oil content of the coated and uncoated French fries using the Soxhlet extraction method.

10:10 AM

Humeshkar Nemala(1), Jagdish Thakur(1), Vaman M. Naik(2) and Ratna Naik(1)
(1) Department of Physics and Astronomy, Wayne State University, Detroit, (2) Department of Natural Sciences, University of Michigan, Dearborn

Behavior of magnetic nanoparticles in an AC magnetic field: Relevance of constraints placed by microscopy and magnetic measurements

Generation of heat by magnetic nanoparticles in the presence of an external oscillating magnetic field is known as magnetic hyperthermia (MHT). This heat is generated by two mechanisms: the Neel relaxation and Brownian relaxation. Understanding the nature of magnetic nanoparticles in the context of MHT has great importance because of its relevance to biomedical applications. Dextran-coated iron oxide (Fe3O4) nanoparticles were synthesized using the co-precipitation method and were characterized using X-ray diffraction, transmission electron microscopy (TEM) and magnetic methods. The MHT properties of these dextran coated iron oxide nanoparticles have been investigated in magnetic fields ranging from 90-190 Oe and at different frequencies in the range of 190-390 KHz. The heat generation, quantified using the specific absorption rate (SAR), is compared with the trend one would observe using the linear response theory (LRT). In the frame work of LRT, we show that physical size constraints placed by TEM along with the measured saturation magnetization, reveal important details about the magnetic nanoparticles.

10:35 AM

Maryam Nazri and Gholam-Abbas Nazri
Frontier Applied Sciences and Technologies, LLC, Bloomfield Hills, Michigan

Advance 3-D conformal Silicon/Carbon Nanofiber-Graphene Composites for Next Generation of Li Batteries

Lithium battery is the most efficient electrochemical energy storage system with high energy density, engineered for high power capability, and potential for low cost, covering a wide range of applications from mWh for electronics to MWh for stationary applications. Next generation of lithium battery may use newelectrode materials with significantly higher energy density to meet more demanding applications such as battery for, auto, space and marine applications. Silicon anode material has the highest known specific capacity, 4,200 mAh/g, more than an order of magnitude higher than the current graphite anode (372 mAh/g). We have engineered a 3-D conformal anode based on silicon anode technology with capacity exceeding 1000 mAh/g, and high capacity retention during charge-discharge cycles.Our technology includes incorporation of a nano composite of silicon coated carbon nanofiber and grapheme sheets embedded in electronically conductive polymers. In this presentation we reports electron microscopy, electrochemical performance and mechanical properties of our anode composite before and after multiple electrochemical charge-discharge cycles.

10:50 AM

Jui-Ching Lin[1] and Yi Qin[2]
[1]The Dow Chemical Company, Analytical Sciences, Midland, MI
[2]Dow Electronic Materials, Advanced Packaging Technologies, Marlborough, Massachusetts

Quantitative Characterization of Intermetallic Compounds Interface between Cu Pillars and Solder Caps Using Focused Ion Beam-Scanning Electron Microscopy

One current research focus in integrated circuit (IC) packaging is the development of novel electroplating chemistries to plate solder cap on copper pillar for flip-chip applications. Controlling the growth of the intermetallic compounds (IMCs) at the solder cap/copper pillar interface is necessary to improve the integrity and reliability of the flip-chip interconnection during the service life of product. Thus, it is important to be able to characterize IMCs quantitatively so that the IMC formation and growth can be correlated with electroplating chemistry. In this study, the growth of the IMC interface of solder caped copper pillars during temperature cycling between 125°C and -55°C was studied using focused ion beam-scanning electron microscopy (FIB-SEM). FIB-SEM is shown to be a powerful tool to study the kinetics of IMC formation.

11:05 AM

Stephanie L. Brock (invited)
Department of Chemistry, Wayne State University, Detroit, MI

Structure, Morphology, and Phase Transitions in Metal Pnictide Nanomaterials as Probed by Transmission Electron Microscopy

Transition metal pnictides (pnicogen = Group 15 element) comprise a large but relatively underexplored class of materials, despite having properties that span the energy landscape. These materials are being investigated in thermoelectric devices (waste heat conversion), batteries (energy storage), catalysis (fuel processing), and magnetic refrigeration (climate control). Critically, many applications of transition metal pnictides will benefit from controlling the architecture of the material on the nanoscale and understanding how microstructure impacts function. This is due to a number of effects including enhanced surface area (catalysis), phonon scattering (reduced thermal transport in thermoelectrics), reduced charge transport distances (Li-ion batteries), physical reduction in size (decreased bit size for data storage), and reduced thermal hysteresis (increased cycling rate in magnetic refrigeration). Research in the Brock group is focused on developing methods for the synthesis of transition metal pnictide nanoparticles that enable exquisite control of size and

morphology en route to control of function. Transmission electron microscopy (TEM) is a central tool for characterization of nanomaterials produced in the Brock lab. In this presentation, the role of TEM in developing patterning strategies for nanoscale arsenides, establishing model systems for hydrodesulfurization catalysis and understanding magnetostructural phase transitions in MnAs nanoparticles will be described.

2:00 PM

Bob Price (invited)
School of Medicine, University of South Carolina, Columbia, SC

Some Aspects of Imaging in Colon Cancer Research

The $APC^{Min/+}$ mouse is a genetic model of gastrointestinal tumorigenesis that involves the adenomatous polyposis coli (APC) gene. Mice that are heterozygous for this allele spontaneously develop multiple adenomatous polyps throughout the gastrointestinal tract. This phenotype is similar to that found in humans with familial adenomatous polyposis, an inherited form of colon cancer. The same gene is mutated in a majority of sporadic human colorectal cancers. Various forms of imaging are important in study of the model and ongoing microscopy projects examining the distribution of bone marrow derived cell (BMDC) infiltration of intestinal tumors, vascular casting, and in vivo confocal imaging of tumor vasculature, and ultrastructural changes that occur in skeletal muscle associated with cachexia in the model will be described.

2:45 PM

Olena Palyvoda
Electrical and Computer Engineering, Wayne State University

Raman Spectroscopy Applications in Biomedicine

Raman spectroscopy (RS) is a non-invasive optical technique, which provides detailed information about the molecular composition of tissue by exciting vibrations of molecular bonds using infrared wavelengths. The complexity of cancer requires multivariate assays and accurate diagnosis. Imaging studies such as CT, MRI, radiography and ultrasonography used to support the diagnosis and stage the tumor. However, despite advances in imaging techniques, there are a number of limitations in sensitivity leading to an inappropriately high rate of misdiagnosed cancers, and an intrinsic inability to prove that a suspicious abnormality is benign or malignant. This has led to the investigation of alternative imaging modalities, such as RS for early non-invasive detection and diagnosis of different types of cancer. Cancer disease leads to chemical and structural changes in tissue that change the vibrational spectra, and that can be used as markers of the disease. Moreover, RS has several advantages over biopsy analysis, including in vivo monitoring, higher sensitivity, easier use and an overall more accurate correlation between cell numbers detected and tumor growth. RS is an extremely powerful technique for characterizing biological systems and can be applied to a wide variety of sample morphologies such as thin sections, native tissue, soft tissue, hard tissue and body fluids.

3:10 PM

Kailey A. Vincent and Philip L. Hertzler
Biology Department, Central Michigan University

Germ granule localization and multivesicular body quantitation during late gastrulation in Penaeus japonicus

Brood farms in the aquaculture industry have bred genetically superior lines of penaeid shrimp, and seek methods to sterilize the organisms to protect the financial investment. The origin of the germ line is not well understood in penaeid shrimp, so more basic research is necessary before sterilization methods can be employed at the molecular level. Previously, a putative primordial germ cell (PGC) was identified at gastrulation based on a nucleus-to-cell size ratio and the cells localization within the embryo. Staining with the nucleic acid dyes Sytox Green and STYO RNA Select have traced the localization of an RNA – enriched intracellular body (ICB) during embryonic development of several penaeid shrimp species. It is hypothesized that the ICB may serve as a germ granule and marker of germ line fate. In *Penaeus japonicus* the ICB has been localized to a single cell from the 4-cell stage through the 122-cell stage by fluorescence staining,, after which it could no longer observed. Ultrastructural examination of the ICB during these stages showed that it is composed of electron-dense granules and multivesicular bodies. This study continues the description of ICB localization and ultrastructure from the 122-cell stage to the hypothesized PGC using electron microscopy, and quantifies the appearance of multivesicular bodies (MVBs) that have been identified within and around the ICB material within the putative PGC.

3:25 PM

Laura Gunther, Kenya Furuta, Jianjun Bao, Yuwen Mei, and Takeshi Sakamoto
Department of Physics and Astronomy, Wayne State University

Two Myosin 5c Molecules on a DNA Scaffold Steps processively along Actin

Myosin 5c is a low duty ratio motor and doesn't move processively along actin filaments as a single molecule. Here, we characterized the kinetic properties of double-headed myosin 5c and examined the possibility that multiple myosin 5c molecules could possess processive movement. Two myosin 5c molecules were conjugated to DNA scaffolds and their processivity was analyzed by single molecule techniques with TIRF and FIONA. ATPase activity assay and ADP dissociation

kinetics demonstrated that the interaction between the two heads of myosin 5c increases its F-actin binding affinity via the “gaited-gate” mechanism. Single molecule study revealed that two myosin 5c molecules, in a complex, moved processively along actin filaments. Moreover, the space distance between the myosin 5c molecules is an important factor for processive movement. Our results provided a novel possibility for a non-processive motor to achieve processive movement that could be used to transport cargo in cells.

3:40 PM

Heckman CA, Weber J, Cayer ML, Boudreau NS
Biology Department, Bowling Green State University, OH

Regulation of cell protrusions by protein kinase C (PKC)

The PKC family of serine-threonine kinases consists of 12 isoforms. Different cell types express different subsets of these isoforms. PKC ‘s substrates include many cytoskeletal proteins, which affect cell shape, adhesion, and motility. Phorbol 12-myristate 13-acetate (PMA) activates PKC, leading to a conformational change in the enzyme and its degradation. In tracheal epithelial cells, PKC-alpha and epsilon show the activation-degradation pattern, whereas PKC-beta does not. We determined whether such activation-degradation cycles affect protrusion formation or turnover. The hypothesis was investigated by introducing knockdown (KD) agents that target specific transcripts. The prevalence of different protrusions was determined by computerized morphometric analysis of the cell boundary. Latent factors, variables mined from the database of morphometric variables collected from each cell, were computed for filopodia (#4) and nascent neurites (#7). The time course was followed for 15 h. A 2-h PMA exposure caused filopodia to decrease in all samples. In epsilon KD cells, the filopodia recovered by 5 h. Since the residual epsilon undergoes activation and degradation, the effect suggested that epsilon must be a filopodia inhibitor. Cells into which DNA with a random sequence was introduced instead of a specific sequence showed a linear increase in neurites after PMA exposure. At times up to 10 h, epsilon KD resembled controls whereas the alpha and beta KD samples declined and later recovered. The time courses suggest that certain PKC isoforms had regulatory effects on neurites but that regulation was more complex than for filopodia. PKCs may be master regulators of adhesion and protrusive activities.

Michigan Microscopy & Microanalysis Society Conference
Poster List, October 18, 2013
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Authors will be at their posters 12:45 PM – 2:00 PM

E. Abdelhamid, R. Mukherjee, D. Mishra, A. Dixit, B. Nadgorny and G. Lawes
Department of Physics and Astronomy, Wayne State University

UV-induced stable photoconductivity in Indium Oxide films

We have investigated the effects of UV radiation on the electrical conductivity of sputter deposited Indium Oxide films for samples annealed under different conditions. The films were annealed in air, hydrogen, argon, nitrogen, and vacuum to modify the microstructure and distribution of point defects. X-ray diffraction shows the formation of polycrystalline single phase films, with the average crystallite size changing under different annealing conditions. Wavelength dispersive spectroscopy (WDS) was used to estimate the Oxygen stoichiometry in the films. We find that the resistance sharply decreases to between 0.1% and 50% of its initial value on exposure to UV irradiation. The magnitude of the decrease depends on the annealing conditions, with the largest relative change occurring in the as-prepared sample (high initial resistance), and the smallest decrease observed in the Hydrogen-annealed film (low initial resistance). This low resistant state is surprisingly stable, having a time constant of several hours or longer to relax to the initial value after the UV illumination is removed. It may be possible to explain these changes in resistance in the light of varying Oxygen content in the films.

K. Bazzi[1], P. Vaishnava[2], V. M. Naik[3], G. A. Nazri[1], R.Naik[1]
[1]Department of Physics and Astronomy, Wayne State University, Detroit, [2]Department of Physics, Kettering University, Flint, [3]Department of Natural Sciences, University of Michigan-Dearborn

Effect of Li Rich on Electrochemical Behavior of $LiFePO_4$ Cathode Material for Li ion Battery

Application of lithium iron phosphate as cathode material in lithium cell is limited for the poor electronic conductivity and slow lithium ion diffusion in the solid phase. Here, we report synthesis of C-LiFePO4 and C- Li1.05FePO4 cathode materials via sol gel method using oleic acid as surfactant that improve the electronic conductivity. Our aim is to investigate the role of excess Li on the electrochemical performance of C-LiFePO4. The phase purity was confirmed by x-ray diffraction. SEM and TEM investigations reveal that oleic acid form a conductive network between the particles, and provides a uniform carbon coating on nano size LiFePO4. The agglomeration is also reduced and spherical particles are formed when excess lithium is used. Our results show that Li1.05FePO4 has lower charge transfer resistance and superior electrochemical performance as compared with that of lithium iron phosphate when stoichiometric precursors are used. The septic capacity, the cycling stability are also improved when excess lithium is used. The correlation between the charge transfer resistance, diffusion coefficient, morphology, and electrochemical characteristics will be presented for C-$Li_{1.05}FePO_4$ and C-$LiFePO_4$.

Kulwinder S. Dhindsa[1], B.P. Mandal[1], M. Lin[1], M Nazri[1], G.A. Nazri[1], V.M. Naik[2], P Vaishnava[3], R. Naik[1], Z. Zhou[1]
[1.]Wayne State University, Detroit [2.]University of Michigan, Dearborn [3.]Kettering University Flint

Enhanced electrochemical performance of graphene modified LiFePO4 as a cathode material for lithium ion batteries

We have synthesized LiFePO4/graphene nano-composites using sol-gel method by adding water dispersed graphene oxide to the LiFePO4 precursors during the synthesis. The graphene oxide was subsequently reduced by annealing the composite at 600oC for 5h in flowing forming gas (90% Ar and 10% H2) which was confirmed by Raman spectroscopy and X-ray Photoelectron spectroscopy. The electronic conductivity of LiFePO4/graphene composite was found to be six orders of magnitude higher than that of pure LiFePO4 synthesized following otherwise the same procedure without the addition of graphene oxide. Scanning Electron microscopy and Transmission electron microscopy images show LiFePO4 particles are wrapped in uniformly distributed graphene sheets throughout the material forming a three dimensional conducting network. At low currents, (C/3), the capacity of the composite cathode reaches 160 mAh/g, which is very close to the theoretical limit. More significantly, the graphene wrapped LiFePO4 shows a dramatically improved rate capability up to 27C, and excellent charge-discharge cycle stability over 500 stable cycles in comparison with the LiFePO4 without graphene.

Matthew Garnett
Earth and Atmospheric Sciences, Central Michigan University
Investigating Cataclastic Contact Boundaries at Trachyte Mesa, Henry Mountains, Utah, USA

Trachyte Mesa is a sill type satellite intrusion related to the lateral expansion of an extinct magma chamber known today as the Henry Mountains. This igneous complex was emplaced into the preexisting sedimentary host rocks at a depth of 3-5km approximately 28 Ma during the Oligocene. The Henry Mountains, including Trachyte Mesa (TM), is presently well exposed through regional uplift and erosion of the Colorado Plateau. The areal extent of TM is approximately 1.5 km long and 0.6 km wide and the rock type is diorite porphyry. The rock is characterized by large ~ 3-10mm crystals of plagioclase suspended in a fine grained matrix composed of crystals ranging from ~ 5-50μm. A feature common to the intrusive/host rock contact boundary of TM is a ~ 3-5 cm band of cataclastic deformation of plagioclase phenocrysts. This phenomenon is intriguing because it is not understood how a liquid magma transfers the shear stress necessary to produce this type of brittle deformation. Research involving modern volcanic systems suggests that silicate melts can cross the glass transition at elevated strain rates, becoming instantaneously solid (glass) (Tuffen & Dingwell, 2005). We hypothesize that during the emplacement of TM elevated strain rates induced a glass transition in the matrix allowing fracturing of the magma (glass) to shatter the plagioclase phenocrysts resulting in the brittle deformation preserved at the contact today. This study used transmitted and reflected light microscopy coupled with SEM BSE and EDS data to document textural evidence preserved at the contact boundary of TM. Through EDS analysis it was determined that three compositionally distinct populations of plagioclase crystals exist in this sample. Additionally, the fine grained matrix was examined for mixing of cataclastic materials within matrix (melt portion of the sample). Textural observations backed by EDS analysis confirms that mixing of cataclastic fragments is minimal at the contact boundaries. BSE images were also examined for evidence of micro fractures emanating from zones of cataclastic plagioclase, of which none were observed. Observed textural features reflect a “healing” of the matrix after cataclasis has occurred.

Suvra S Laha and Gavin Lawes
Department of Physics and Astronomy, Wayne State University, Detroit, MI
Synthesis and characterization of boron stabilized Mn_3O_4 nanoparticles

The synthesis of phase pure Mn3O4 nanoparticles can be challenging because of its ready conversion to other Mn oxide phases, particularly Mn2O3. However, our recent experiments have shown that incorporating a small percentage of boron could stabilize the spinel structure in these nanoparticles and prevent the unwanted conversion to other oxide phases. Both undoped and boron doped Mn3O4 nanoparticles were synthesized using a chemical co-precipitation method. The structural characterization involving the shape, size and morphology of these nanoparticles was studied using X-ray diffraction and also by transmission electron microscope. We find that the undoped nanoparticles show multiple Mn oxide phases, while the boron doped samples are phase pure. Electron micrographs show the presence of small particles, which we tentatively identify as B2O3, in samples having larger boron fractions, while the more lightly doped samples show only the Mn3O4 nanoparticles. We then correlate the structural properties of these nanostructures by magnetic measurements through ac susceptibility studies.

Yuwen Mei, Cameron Pinnock, Laura Gunther, Karen Beningo, Jianjun Bao, and Takeshi Sakamoto
Department of Physics and Astronomy, Wayne State University
Three dimensional (3-D) vesicle trafficking using super resolution microscopy

Intracellular transportation of organelles, macromolecules, and other vesicles by molecular motors is crucial for cellular function. Defects in transporter machinery have been implicated in various pathological processes including neurodegeneration and autoimmune diseases. Therefore, understanding the mechanistic basis of molecular motor in cargo transport is fundamental to understand the disorders that are caused by motor deficiency.

We focus on class V myosin, which is actin-based molecular motors responsible for short-range cargo transport in cell periphery. In vertebrates, there are three class V myosin genes encoding three isoforms, named myosin Va, myosin Vb, and myosin Vc. myosin Vc is enriched in epithelial and glandular tissues, including the pancreas, prostate, mammary, stomach, colon and lung. Over-expressed myosin Vc has been found to be associated with secretary vesicles and involved in vesicle trafficking and secretion in MCF cells and in lacrimal gland acinar cells, respectively. However, the exact role of myosin Vc in the above processes is not clear. In addition, though proteomic analysis identified myosin Vc as the only motor localized at the surfaces of pancreatic zymogen granules, its biological function remains to be clarified. To understand the movement pathway of vesicle trafficking with myosin Vc, we have developed super-resolution microscope to track with three dimensional movements. Our microscope has 1 ~ 10 nm special resolution and 30 frame per second temporal resolution.

Rupam Mukherjee
Dept of Physics and Astronomy, Wayne State University
Quantitative analysis of percolating cluster using SEM/EDX spectrometer in binary composite system

Calcium copper titanate (CCTO) is a widely investigated perovskite system having an exceptionally large dielectric constant. Because of its very large intrinsic dielectric response, CCTO is a particularly attractive material for exploring the enhancement of dielectric properties near the percolation threshold on mixing with

a conducting component. In order to explore this possibility, we prepared composites of CCTO and RuO2 having a range of compositions by solid state as well as by sol-gel techniques. Scanning electron microscopy (SEM) and Energy dispersive x-ray (EDX) provides a detailed microstructure analysis of CCTO and composites. The SEM image reveals the grain size of CCTO to be around 1micrometer and is surrounded by molten copper oxide. Interestingly it is found out from EDX spectrometer that the solid grains are titanium rich whereas the grain boundary which is molten region surrounding the particle is copper rich which strongly supports the idea of internal barrier capacitance effect. This effect is being used by percolation network in RuO2-CCTO composite system where we found that dielectric constant has increased by a factor of 3 which can indeed increase the efficiency of microelectronics devices in near future.

Lucas Calloway and Elizabeth Alm
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Binding Efficiency of Environmental Escherichia coli to Sediment Particles Compared to Human Intestine Isolates

Beach quality is a major concern for many beach goers, as well as beach managers who want to keep these beaches from closing. E.coli are the most common fecal indicator bacterium, and are also able to establish and grow in the beach sand once introduced to the environment. Binding to sand particles is an important adaptation, allowing these microbes to survive in environmental conditions. This research investigated how well human E .coli isolates can bind to sand particles compared to beach E. coli isolates. Sand binding assays were performed on 10 human E. coli isolates and 10 beach E. coli isolates. Binding to sand columns was used to select 2 isolates with high binding affinity and 2 isolates that had weaker binding affinity. Scanning electron microscopy was used to visualize E.coli on sand particles. Colonies were counted and the CFU/mL and the number of cells was calculated. There was significant difference between the two populations' binding activities (insert T-test results), with beach sand E. coli binding to sand better than human E, coli. Isolates Beach1, Beach 9, Intestinal 1, and Intestinal 4 had the greatest difference between the pre and post sand binding assays among the isolates, which means these isolates showed the greatest binding efficiency. Therefore, they were fixed by way of Osmium tetroxide vapor fixation then sputter coated and viewed under a Hitachi 3400N-II Scanning Electron Microscope at 3.0kv.

Daniel DeSantis, Brian Leroux, Joanne Dannenhoffer
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Cell Differentiation in Corn Endosperm

Cereal endosperms provide nutrition to humans and livestock all over the world. Corn, Zea mays is the most widely grown cereal crop in the Americas. Corn endosperm is loaded with carbohydrates that eventually serve as a vital food source for the developing seedling. Within the endosperm, cells differentiate and developed unique characteristics that correlate to their specific function. The aleurone is the most peripheral single layer of cells around the sides of the endosperm. Basal endosperm transfer layer (Betl) makes up a single cell layer at the base of the kernel where it is attached to the plant. Starchy endosperm (SE) cells fill the majority of the volume of the kernel. These three areas have been well documented and their functions known. Two areas that are not well known are the basal intermediate zone (BIZ) located adjacent to the BETL and the conducting zone (CZ) which is located apically to the BIZ. This study will describe the characteristics found in the five different cell types emphasizing the BIZ and CZ. Material and Methods Zea mays inbred line B73 was field grown, and developing kernels were harvested, and placed in fixative of 4% formaldehyde/1% glutaraldehyde in 50mM KPO4 pH 7 and stored at 4oC until processing. Longitudinal hand sections of kernels were taken through the center of the kernel and regions of the endosperm were dissected. Dissected kernels were rinsed in 50mM KPO4 buffer pH 7, then post fixed in 4% OsO4 solution overnight in fridge at 4oC. They were then washed in 50mM KPO4. Kernels were dehydrated in a graded ethanol series, followed by 3 changes of 100% ethanol. The kernels were infiltrated in Spurr's resin, embedded longitudinally polymerized in a 70°C oven. The plastic blocks were then trimmed and sectioned at 2µm using a Powertome X. Thick-sections were stained in 1% Toluidine blue in 1% NaBO4 and visualized using a Zeiss Axiocam camera on a Zeiss Axiophot bright field microscope. Samples prepared for TEM were sectioned at a thickness of 70nm.

Kristen Karasiewicz, Andrew Foote, and Philip Hertzler
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Vasa and Nanos Protein Localization in the Germ Line in Penaeid Shrimp

Australia's aquaculture is a growing economic market and provides close to 50% of the world's seafood consumption. As a result of population growth and higher demands, brood stocks of penaeid shrimp have been bred. Producers now seek methods to sterilize them to protect their financial investment. Efforts to produce sterile shrimp by ionizing radiation and polyploidization have proven unsuccessful. An alternative approach to induce sterility would be to inhibit germ line development and gamete formation. Despite the huge economic importance of penaeid shrimp, little is known about the development of the germ line. We do know that there are similarities in genetics within the germ line to other organisms, specifically the primordial germ cells (PGCs), which eventually divides and migrates toward the developing gonads where they will differentiate into gamete stem cells. There is a specific and defined gene expression in the germ line different from that of the somatic cells early in embryogenesis. With the help of suggested genes from a "gene tool kit" as known germ line markers, we are beginning to look at Vasa and

Nanos expression within the germ line to trace the PGC throughout development. This will determine the precise correlation between Vasa and Nanos to the germ line, gamete production, and adult ovaries for Penaeus japonicus shrimp. These finding will help with the understanding of penaeid shrimp germ line development and protein expression in the efforts to determine an effective and efficient method of sterilization.

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Investigating the Membrane-Binding Activity and Localization of Copine Proteins in Dictyostelium

Copines are a family of membrane-binding proteins found in many diverse organisms and are hypothesized to be involved in cell signaling pathways. Copines have two C2 domains, which typically confer calcium-dependent lipid-binding activity. The C2 domains are followed by an A domain, which is similar to the VWA domain found in integrins and is thought to be a protein-binding domain. We are using Dictyosteliumdiscoideum to study copine (cpn) function and have focused our work on cpnA. To study the other five copine genes, cpnB-cpnF, we obtained full-length cDNA clones of cpnB and cpnE and partial cDNA clones of cpnD and cpnF. We used PCR to create full-length cDNA clones for cpnD and cpnF by adding the missing bases to the primers. We are using RT-PCR to create the cDNA for cpnC. To determine the intracellular location of each of the Copine proteins, we are tagging each protein with GFP. We have created constructs to express CpnB and CpnE tagged with GFP at either the N or C-terminus. Using fluorescence microscopy, we observed GFP-tagged CpnB and CpnE in the cytoplasm and associated with intracellular organelles. CpnB was also observed in the nucleus in some cells. Membrane binding assays indicated that CpnB and CpnE with GFP at the C-terminus pelleted with membranes in a calcium-dependent manner; however, when the GFP was at the N-terminus, the GFP-copine proteins pelleted with membranes in a calcium-independent manner.

Alicia Trombley
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Presence of RNP Granules and Nuclear Membrane Blebs in Caenorhabditis elegans cgh-1 mutants

As women age, fertility decreases. This is likely due to the fact that some protective mechanism is failing with age. To study this biological problem, we use the model system C. elegans. In this hermaphroditic nematode, ovulation arrests when sperm is depleted, large RNP granules form within the oocytes and there is an increase in nuclear blebbing. We believe RNP granules function to preserve oocyte quality while fertilization is delayed. RNP granules have many components, including CGH-1, which is a P body protein that is required for both oocyte and sperm function. Nuclear blebs are thought to serve as a mechanism for increased trafficking of nucleoporins, which aids in the assembly or RNP granules (Patterson et al., 2011). Since the presence of the protein CGH-1 is required to prevent the apoptosis mechanism from being activated, a lack of CGH-1 may be expected to trigger the formation of nuclear blebs along the nuclear membrane (Navarro et al., 2001). I hypothesized that due to the lack of CGH-1 protein in cgh-1 mutants, many nuclear blebs and RNP granules would be observed. I detected the presence of both RNP granules and nuclear blebs in C. elegans cgh-1 mutants.

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Sharing fat: Lipid droplet interactions with organelles in brown adipose tissue

Adipocyte lipid droplets (LD) store neutral lipids as triacylglycerols (TAG) which upon hydrolysis generate fatty acids (FA). LD-organelle interactions may play a critical role in directing fuel for other tissues such as excess FA. Structural evidence of FA transport to mitochondria for β-oxidation is still under investigation. The LD biogenesis model assumes that nascent LDs arise from the smooth endoplasmic reticulum (SER). However, possible fat mobilization between adjacent LDs and nascent LDs through the SER network remains to be understood. Brown fat tissue collected from warm bodied and cold exposed mice were analyzed by conventional transmission electron microscopy (TEM), fluoronanogold TEM, and electron tomography (ET). The fluorescent recovery after photobleaching (FRAP) technique was used to study LD-LD interactions in live tissue. TEM and ET depicted close apposition of LDs to SER and mitochondria. The SER network partially wrapped the mitochondria and LDs. Seipin was localized only to the SER around LDs. Lamellar whorls, indicative of lipolysis, were adjacent to mitochondria and LDs. The FRAP technique illustrated a recovery in fluorescence of bleached LDs, implicating an exchange of FAs between adjacent LDs. Our data suggests that FAs channel between LD-organelles and adjacent LDs, however the structural basis remains unclear.