[AIMS] Arizona Imaging and Microanalysis Society

Using light, electrons, ions, electromagnetism and x-rays

AIMS Newsletter Volume 6, Issue 2

PRESIDENT'S NOTE

Brooke Beam, AIMS 2012-2013 President

Greetings! I am looking forward to another interesting and challenging year of imaging. This year's annual conference will be held on March 7th, 2013 at the University of Arizona in the South Ballroom of the Memorial Student Union. Before we get to the details of this year's event, I would like tell the organizers **THANK YOU** for putting on such a great meeting in 2012! In particular, I would like to acknowledge Page Baluch (Past-President), Peter Crozier (Treasurer), Webmaster Charles Kazilek , and all the others who worked hard to make the 2012 AIMS conference at ASU a success. We would also like to thank our 2012 **Platinum** (EDAX/AMETEK, Electron Microscopy Services, FEI, GATAN, Photometrics, QImaging) and **Gold** (Boeckeler Instruments, Buker Axs Microanalysis, Carl Zeiss Microimaging, Hamamatsu Corp., JEOL USA, Keyence, Leica Microsystems, Nikon Instruments, Olympus America, Oxford Instruments, Southwest Precision Instruments, Ted Pella, Thermo Fisher Scientific, Tescan) corporate sponsors. The annual AIMS conference would not be possible without the generous financial support of these vendors.

We hope that you are planning to come learn and network with colleges and vendors at the 2013 conference at the University of Arizona in the South Ballroom of the Memorial Student Union. Registration for the conference is a **two-step** process. You must first register for membership online at www.azmicroscopy.org at the student, individual or corporate level. Then you can register for free admission to the AIMS conference. Corporate members have the option to register at various sponsorship levels which includes a booth at the conference. Due to limited seating only those registered for the conference will be admitted to the luncheon. I look forward to seeing you there!

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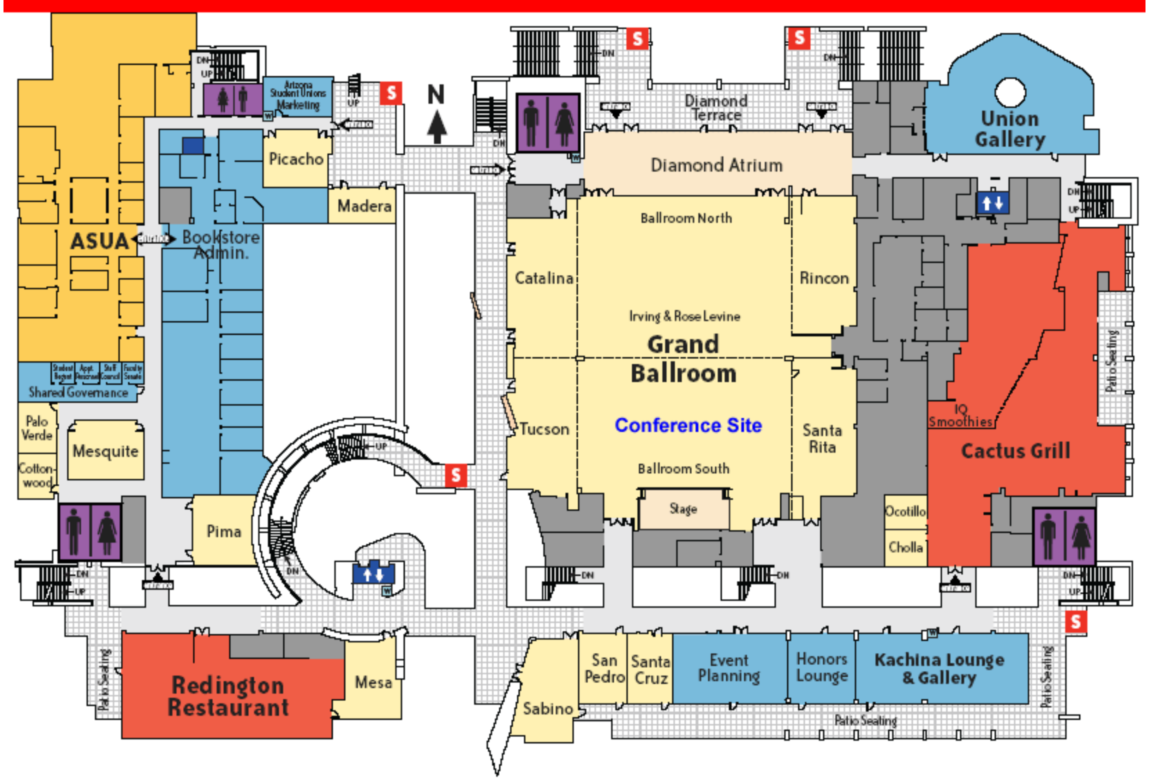
MARK YOUR CALENDARS: AIMS 2013 MEETING:

The Student Union at the U of A mall

The 2013 AIMS conference will be held at the University of Arizona in the Student Union South Grand Ballroom on March 7, 2013 from 8:00AM to 5:00PM

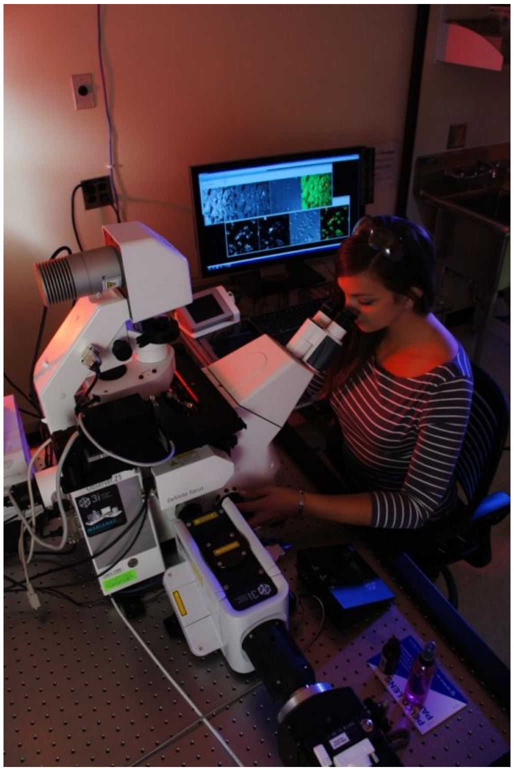
Conference Site Layout at the Student Union

(One floor above the ground level)



WHAT'S NEW:

Univ of AZ: A new spinning disk fluorescence microscope.

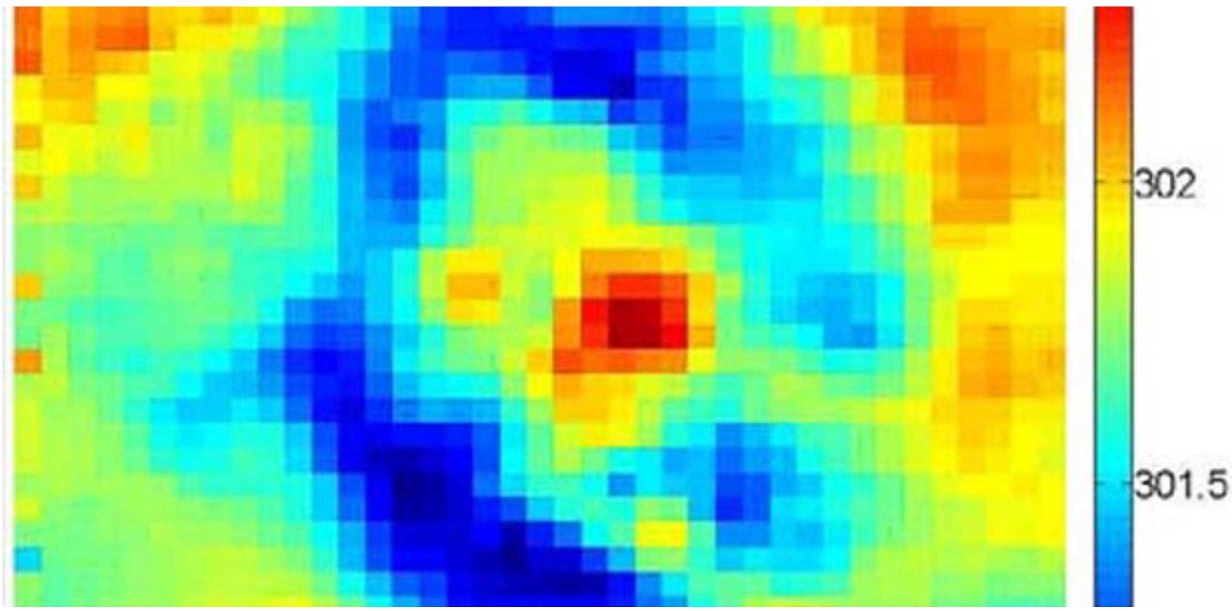


The Keck Center for Surface and Interface Imaging in the Chemistry & Biochemistry department at the University of Arizona installed a new spinning disk fluorescence microscope in July of 2012. The microscope from Intelligent Imaging Innovations (3i) is built on a Zeiss Marianas microscope with a Yokogawa spinning disk system, and an Evolve 512 CCD from Photometrics. A spinning disk confocal microscope uses Nipkow disks rotating at 5000 rpm to excite samples and project confocal fluorescence images onto a CCD. One Nipkow disk is constructed of an array of pin holes with micro-lenses to focus excitation light onto the sample. Emission light passes back through the second Nipkow pinhole disk array to exclude the out-of-focus emission from the images collected; thus increasing the signal to background of fluorescence images. This system has acquisition speeds of less than 30 frames per second, which is appropriate for dynamic or live cell imaging. The microscope is outfitted with a Z piezo stage from ASI which allows fast collection of a Z stack of 2 D images for reconstructed of a 3D image of the sample. Additionally differential interference contrast (DIC) trans-illumination imaging is available for all of the objectives. DIC adds contrast to areas of the sample where there is a gradient of refractive index making previously transparent objects visible. One of the applications of this microscope is Chemotaxis research in Pascal Charest's group. Using Dictyostelium discoideum as a model system Dr. Charest is particularly interested in understanding how signaling pathways and molecular mechanisms control directed motion in eukaryotic cells.

[AIMS]

University of Arizona at Work on New Terahertz Spectral Imager

This custom-made unit -- nothing like it currently exists -- will provide researchers with additional information on tumors and pathogens



Researchers at the University Of Arizona College Of Engineering received a grant to develop a new medical imaging technology to detect tumors and pathogens. The method is based on the terahertz block of the electromagnetic spectrum. The scarcely researched terahertz band lies between microwave and optical and all these spectral frequencies can be used for imaging. Although terahertz radiation can penetrate many different materials, including clothing, but not metal, it does not do ionizing damage to cell tissues and DNA like X-rays.

The custom-made spectral imager will emit electromagnetic radiation and analyze how the spectra are absorbed and reflected by various materials, such as cell tissues and chemical compounds. No instrument with the spectral imager's proposed capabilities currently exists. It will enable scientists and engineers to expand the frontiers of research in areas such as medical imaging of tumors and pathogens and detection of specific chemicals such as explosives.

Richard Ziolkowski, professor in computer engineering and principal investigator in this project, made the following comments: It will be a unique instrument in an area that is really starting to grow. There are jobs now being created in the terahertz area because people are interested in systems such as these imaging devices.

You get some depth of penetration with terahertz, for example into skin and through clothes. You can't do that with visible light. We'll be sending out these terahertz signals and receiving signals back and trying to interpret them.

One possible application for a terahertz spectral imager is in skin cancer surgery. Determining the extent of a melanoma can be difficult when using harmful X-rays. Similarly, the instrument development team is interested in using terahertz waves to detect the presence in cells of disease-causing pathogens such as bacteria and viruses. Different bugs have different spectral signatures, Ziolkowski said.

ASU Southwestern Center for Aberration Corrected Electron Microscopy

This is a very exciting time in LE-CSSS. The Southwest Center for Aberration Corrected Electron Microscopy (SW-ACEM) was dedicated earlier this year when we installed a JEOL ARM200F atomic-resolution scanning transmission electron microscope. The ARM has been performing extremely well, supporting the needs of researchers within ASU and an increasing number of industrial users who require, not just advanced microscopy, but also an ultra-stable environment for atomic-scale investigation. SW-ACEM is about to take delivery of its second aberration corrected STEM, the Nion Monochromatic UltraSTEM. In addition to atomic spatial resolution in STEM images, this instrument will have unprecedented spectral resolution for electron energy loss spectroscopy. With an energy spread of just 11 meV, this instrument will open a new world of EELS at the atomic scale.

SW-ACEM presently houses a **JEOL ARM200F** aberration corrected scanning transmission electron microscope that affords resolution down to 0.8A at 200kV and slightly lower resolution at 120kV and 80kV. Ultra-fast Gatan EELS spectroscopy allows atomic level mapping.

In December 2012 the Center will finalize installation of a **Nion UltraSTEM™ 100** aberration corrected microscope designed for resolution at 0.8A at 100kV, 60kV and 40kV. In addition, the UltraSTEM has a custom-built monochrometer designed to provide EELS resolution down to 30meV.

The UltraSTEM™ 100 is a high-performance dedicated scanning-transmission electron microscope (STEM) with many unique features. Its flexible column provides < 1 Å resolution imaging as well as rapid nanoanalysis with an atom-sized electron probe containing >0.5 nA of current, and efficient coupling into a variety of detectors. It can also produce high-quality diffraction patterns and even CTEM images.

The UltraSTEM™ has produced atomic-resolution elemental maps in less than a minute (see results). This promises to lead to a new era in electron microscopy in which atomic-resolution elemental maps become a powerful addition to the range of available microscopy techniques. It has also produced unsurpassed images of graphene and similar light-Z materials, while operating at 60 keV, below the knock threshold for C and other light atoms.

The principal design elements of the UltraSTEM that have made this advance possible are:

- high-brightness cold field emission electron gun (CFEG)
- high-performance 3rd generation C3/C5 aberration corrector
- ultra-stable sample stage using detachable sample cartridges
- optimized EELS coupling optics
- UHV construction
- complete remote operability, including sample exchange

The LeRoy Eyring Center: a state-of-the-art Electron Microprobe - the JEOL JXA-8530F HyperProbe.

Our new JEOL JXA-8530F Hyperprobe features a field emission electron gun and a wavelength dispersive X-ray spectrometer (WDS). The FE electron gun produces an extremely small spot size at low voltage, allowing for precise elemental analyses of sub-micron areas (approaching 100nm) with high X-ray spatial resolution. A combined WDS and EDS system provides a powerful tool for data acquisition of quantitative analyses, high magnification beam scan mapping and large area stage scan mapping. The capabilities of an electron microprobe are fundamental to many types of research at ASU and among industrial users, including geochemistry, hydrology, petroleum research, soil science, and sedimentology, as well as various aspects of biology and metallurgy.

ASU: Jason Ng, Master of TEM Sample Prep

Jason Ng has rejoined the LeRoy Eyring Center with a strong skill set in precise sample preparation for Electron Microscopic analysis. Jason brings 14 years of experience in preparing semiconductor samples for TEM/SEM characterization, using a variety of techniques including precision hand cleaving, tripod polishing, prethinning, dimpling and ion milling. Jason has five years of experience utilizing Focused Ion Beam, SEM and EDS techniques, including several years mastering lift-out preparation. During his career, Jason has been exposed to a wide variety of semiconductor technologies including, Si, Ge, HfO_2, GaAs, HgCdTe, Al_2O_3, SiC, MgO and InGaN. Jason received his Bachelor of Science in Mechanical Engineering and Master's Degree in Material Science and Engineering (with an emphasis on semiconductor characterization) - both from ASU. This background, coupled with his hands-on experience, gives Jason a fundamental understanding of how materials react to heat, stress and vibration.

[AIMS]

Univ of AZ: AZ Health and Science Center awarded new biological TEM from NIH grant

The AHSC Imaging facility has been awarded a Tecnai G2 Spirit 20-120 kV Transmission Electron Microscope.

The microscope has a high-contrast BioTWIN objective lens optimized for 2D and 3D imaging of stained or even unstained, low-contrast samples. This instrument is high resolution, digital, and easy to use. This microscope is ideal for all biological TEM specimens, ranging from ultra-thin sections to negatively stained samples.
This instrument was delivered with a 4 MP (2k x 2k) side mount camera. The 'scope is capable of automatically stitching multiple images together, so higher resolution images can be accomplished without loss of field-of-view.

Key Features:

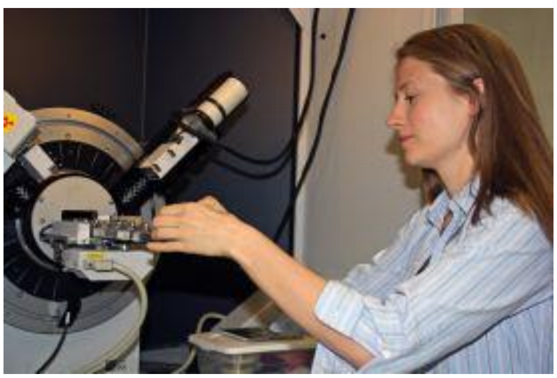
- Easy enough for novice users in transmission electron microscopy
- Designed for 2D and 3D imaging of cells, cell organelles and soft matter
- High level of automation with customized protocols for diverse applications
- Optimized for cryo electron microscopy
- Total solution for dual-axis 3D tomography
- Ergonomic design for operational comfort
- High contrast and high resolution for 20 kV to 120 kV operation

Mars Mission Red All Over: Celebrating Curiosity in Tucson

On August 5, 2012, at 10:32 pm PDT, a landing signal that had been sent 14 minutes earlier from the surface of Mars finally reached Earth, confirming that the robotic explorer Curiosity had successfully touched down.

The 6-wheeled Curiosity rover, about the size of a compact car, carries 10 scientific instruments. UA investigators are working directly on two of them. The event evoked memories of other great UA Mars mission successes, such as the 2005 HiRISE High Resolution Imaging Science Experiment and the 2008 Phoenix Mars Mission. While the crowd rejoiced, three UA community members got to celebrate the triumph personally, for their hands and minds helped shape – and will continue to shape – the 2-year interplanetary expedition.

Stacked in drawers upon drawers, Downs' lab houses the world's most comprehensive mineral collection, representing about half of the world's known mineral species. (Photo by Beatriz Verdugo/UANews)



Shaunna Morrison loads a mineral sample onto the tray of an X-ray diffractometer in the Downs lab. The X-ray machine on Curiosity is much lighter and smaller than any instrument on Earth. (Photo by Beatriz Verdugo/UANews)

Downs and Morrison are members of the science team in charge of CheMin, one of 10 scientific instruments mounted on the rover. CheMin, short for chemistry and mineralogy, is the first X-ray diffractometer ever sent to space, said Downs "It works by shooting X-rays at a rock sample, which interact with the atoms in the rock and send back signals that are like fingerprints," he explained. "It's the standard for identifying minerals, just what you would do in a lab here on Earth." Once CheMin has finished analyzing a rock sample, which can take up to 10 hours, Curiosity will send the data to Earth, where Downs and Morrison will be among those who gather the data and interpret them.

Downs has accumulated the largest database of minerals in the world. About 5,000 small vials, neatly labeled and stored in a cabinet in his lab, represent about 2,200 species of the approximate 4,600 known Earth minerals, more than any other lab in the world. The scientists will use that database to figure out what minerals make up the sample that Curiosity scooped up millions of miles away based on its X-ray "fingerprint," which is unique to each mineral.

"The beauty of X-ray diffraction is that even if we get a sample of an unknown mineral, we can figure out its exact chemical composition and structure."

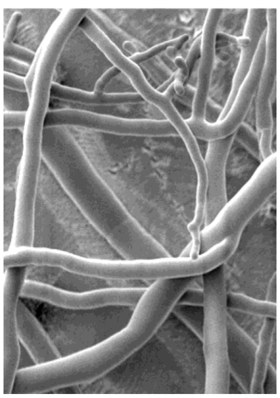
Another instrument, ChemCam, short for chemistry through the camera, combines a camera with a mass spectrometer to analyze rocks from a distance. In Star-Wars-like fashion, ChemCam, mounted onto the rover's mast, will shoot a laser beam at a rock up to 23 feet away, vaporize a small amount of it and a spectrometer will analyze the rock's chemical composition.

2013 AIMS SPONSORS

The annual AIMS conference relies on support from our sponsors. The annual AIMS conference support requests will be mailed out in November. Vendors are asked to contact Brooke Beam bbeam@email.arizona.edu for detailed information on how you can continue your support or become a new sponsor for the upcoming AIMS 2013 Conference.

SEND US YOUR IMAGES

We continue to encourage all our members to submit their exciting and eye-catching images for the AIMS web site. Recently Dr. Robby Roberson has been proving that microscopy is not just for science and scientist. His images have been exhibited at several Arizona Galleries including the Tilt Gallery in Phoenix and the Arizona Science Center also in downtown Phoenix.



The Fungal Body – Robby Roberson (ASU)

Scanning-light macrograph of a shell (Chama conregatta) from the Chester Melville collection housed at the ASU School of Life Sciences. (Charles Kazilek & William Sharp)

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