Tuesday Lunch, October 21, 2008

Exhibitor Workshops
Room: Exhibit Hall - Session EW-TuL

Exhibitor Workshops
Moderator: R. Langley, Consultant

12:20pm **EW-TuL1 Combining AFM and Instrumented Nanoindentation for Mechanical Characterization of Materials at the Nanoscale**, ***A. Bonilla***, Asylum Research

Nanoindentation applications have been a popular technique for characterizing a wide range of materials at the nanoscale. This workshop will discuss the Asylum Research NanoIndenter for true quantitative measurements. Unlike other commercially-available cantilever-based (AFM), the NanoIndenter drives the indenting tip perpendicular to the sample. The force is computed as the product of the spring constant and the measured indenter flexure displacement. This measurement is done by converting the vertical flexure displacement into an optical signal measured at the standard MFP-3D photodetector. Because the two quantities of indentation, depth and force, are computed based on displacements measured with AFM sensors, the indenter has unprecedented resolution. The NanoIndenter is also the first commercially-available instrumented nanoindenter that allows high voltage piezoresponse force microscopy (PFM) measurements. The NanoIndenter can operate, as well, when the sample is heated up to 300° C and under fluid. The technology and operation will be discussed along with current application examples including PFM.

12:40pm **EW-TuL2 Manipulation and Characterization of Nanoobjects in SEM**, ***H. Koop***, attocube systems AG, Germany

Ultra-high precision spatial positioning of objects is of prime importance in the emerging field of nanotechnology. attocube systems, a German company located in Munich, manufactures and provides ultra-high precision spatial positioning systems and complete probing tools which are particularly suitable for extreme environmental conditions such as cryogenic temperatures (10 mK – 300 K), high magnetic fields (+31 T) and ultra high vacuum environments (5 x 10-11 mbar). attocube systems' ultra-compact positioning devices enable linear, angular and rotational movement of samples or probes. They are offered in different sizes, as well as materials, and feature an unprecedented variety of applications particularly suitable for extreme environmental conditions. This represents a revolutionary advancement in the field of nano-positioning, leading to new research possibilities in many areas. Applications for these outstanding nanopositioning devices, well-known in many labs around the world, include, amongst other methods, SPM techniques such as confocal microscopy, scanning force microscopy, scanning tunneling microscopy, near-field optical microscopy, and scanning electron microscopy. Due to the unique working principle attocube's nanopositioners are dedicated for usage in challenging application areas where the combination of high accuracy on one hand and large positioning range on the other one is required. Their excellent performance makes them consequently highly suitable for Scanning Electron Microscope (SEM) applications. The necessity of specific SEM tools and equipment for new fields for research and application becomes more important, particularly as the progress on nanofabrication moves the critical dimensions below the optical resolution limit. There is already a wide range of applications available using attocube's SEM tools. One highly sophisticated system is an SEM probe station allowing the manipulation of nanoobjects on sub-nm level as well as the characterization of electrical properties under SEM conditions, simultaneously. The highest level of usability and flexibility offers attocube's new Atomic Force Microscope (AFM) fully integrated into SEM. By combining major advances of these complementary systems, it is possible to run all AFM applications having full visible access to the tip position with respect to sample. For further technical information concerning attocube systems' products, please visit the website www.attocube.com.

1:00pm **EW-TuL3 Momentum Microscope for Angular and Time Resolved Imaging of Valence Band Electron States**, *B. Krömker,* Omicron Nanotechnology GmbH, Germany, *M. Escher,* FOCUS GmbH, Germany, *D. Funnemann,* Omicron Nanotechnology GmbH, Germany, *D. Hartung, H. Engelhard,* Max-Planck-Institut für Mikrostrukturphysik, Germany, ***K. Winkler,*** Omicron Nanotechnology GmbH, Germany, *J. Kirschner*, Max-Planck-Institut für Mikrostrukturphysik, Germany

We demonstrate the application of a novel design of a photoelectron microscope in combination with an imaging energy filter for momentum resolved photoelectron detection. We image the complete momentum distribution of photoexcited electron states in an energy plane through the Brillouin zone. The basic concept of the microscope is to project the momentum image from the back focal plane of the objective lens of a Photoelectron Emission Microscope (PEEM) through an energy filter onto an image detector. Our design is based on a PEEM with an imaging energy filter. The spherical (α^2) aberrations of the imaging energy filter are strongly reduced by a novel analyzer design. Together with a time resolved imaging detector it is possible to combine spatial, momentum, energy and time resolution of photoelectrons within the same instrument. The time resolution of this type of energy analyzer can be reduced to below 100 ps. The complete ARUPS pattern of a Cu(111) sample excited with He I, is imaged in parallel and energy resolved up to the photoelectron emission horizon (at ±90°). Excited with a Mercury light source ($h\nu$ = 4.9 eV) the Shockley surface state at the energy threshold is imaged clearly in k-space. With the high transmission and time resolution of this instrument, possible new measurements are discussed: Time and polarization resolved ARUPS measurements, probing changes of bandstructure due to chemical reactions, in-situ thin film growth and investigation of phase transitions e.g. melting or martensitic transformations.

1:20pm **EW-TuL4 Combined Mechanical and Optical Analysis Methods for Surfaces and Coatings**, ***J. Powell***, CSM Instruments

In the matter of materials development and device design, the optimization of material properties is instrumental to success of a coating system or surface functionality. CSM Instruments, a company specializing in advanced mechanical surface characterization, offers a wide range of mechanical contact-based testing instruments at the micro- and nano-scale for this purpose. This includes indentation testers for hardness, elastic modulus, creep, and fatigue behavior, tribometers for coefficient of friction and wear measurement, and advanced scratch testing tools for analysis of coating adhesion, scratch resistance, and viscoelastic recovery. To fully characterize a materials' behavior, these tools can be integrated with atomic force (scanning probe) or confocal microscopy to "complete the picture", allowing you to quantify pileup volume and height, indentation depth and width, scratch track width and angle, and spall (chip) size and shape, amongst other deformation features. This presentation will discuss how mechanical and optical tools can be easily combined on a single testing platform. A number of interesting examples from materials research and industrial design centers will also be presented, with explanation of what can be learned from each capability.

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