Tuesday Morning, October 30, 2012

Exhibitor Technology Spotlight
Room: West Hall - Session EW-TuM

Exhibitor Technology Spotlight
Moderator: D. Surman, Kratos Analytical Inc.

10:00am **EW-TuM7 ORION Nanofab: Fabricating sub 10 nm Nanostructures using the Helium Ion Microscope**, ***D. Elswick***, Carl Zeiss

The helium ion microscope (HIM) takes advantage of an atomically sharp source to emit a beam of focused He ions so the microscopist today can go beyond imaging resolutions achieved in the Scanning Electron Microscope (SEM). Imaging with ions rather than electrons offers many advantages including the ability to image uncoated non conducting samples at high resolution without damage. Additionally, helium ions can be used to sputter material for nanolithography and nanopatterning applications where sub 10 nm structures are desired. A gallery of helium ion microscopy results will be presented to showcase the capability and performance of this novel microscope. The HIM has proven invaluable at characterizing uncoated biological samples as well as other soft materials. Features sizes and material removal via conventional Ga FIB systems is now surpassed using HIM. The HIM-FIB has touched a wide array of applications that range from nanomachining 5 nm pores for single molecule detection to patterning devices in graphene and creating nanophotonic devices in thin films.

10:20am **EW-TuM8 AM-FM and Loss Tangent Imaging–Two New Tools for Quantitative Nanomechanical Properties**, *R. Proksch, I. Revenko, S. Hohlbauch, J. Cleveland, N. Geisse, A. Moshar, J. Bemis, C. Callahan,* ***K. Jones***, Asylum Research

Amplitude-modulated Atomic Force Microscopy (AM-AFM), also known as tapping mode, is a reliable and gentle imaging method with widespread applications. Previously, the contrast in AM-AFM has been difficult to quantify. In this work, we introduce two new techniques that allow unambiguous interpretation of material properties. AM-FM imaging combines the features and benefits of normal tapping mode with quantitative and high sensitivity of frequency modulated (FM) mode. Briefly, the topographic feedback operates in AM mode while the second resonant mode drive frequency is adjusted to keep the phase at 90 degrees, on resonance. With this approach, frequency feedback on the second resonant mode and topographic feedback on the first are decoupled, allowing stable, robust operation. The FM image returns a quantitative value of the frequency shift that in turn depends on the sample stiffness and can be applied to a variety of physical models. Loss tangent imaging is a recently introduced quantitative technique that recasts phase imaging into a term that includes both the dissipated and stored energy of the tip sample interactions. Quantifying the loss tangent depends solely on the measurement of cantilever parameters as a reference position. These two quantitative techniques can be performed simultaneously. To illustrate this, we will present an example of a micro-cryotomed, cross-sectioned area of a coffee bag packaging material that has been imaged. The loss tangent image shows the highly lossy "tie" layers connecting the low loss metal layer with two vapor-barrier polymer layers. The AM-FM image shows the relative stiffness of the five layers, with the metal layer being the stiffest and the tie layers the softest. As a second example, we imaged graphene deposited onto SiO_2, where the softer graphene layer showed a lowered resonance and the loss tangent imaging revealed a dissipative region between SiO_2 and graphene.

Tuesday Lunch, October 30, 2012

Exhibitor Technology Spotlight
Room: West Hall - Session EW-TuL

Exhibitor Technology Spotlight
Moderator: D. Surman, Kratos Analytical Inc.

12:20pm **EW-TuL2 Complementary Nature of XPS and Raman Techniques**, ***R. Kershner***, *T. Nunney*, Thermo Fisher Scientific

The increasingly complex nature of structure-property investigations in bulk, nanostructured, and thin-film applications has demanded a renewed focus on complementary techniques for chemical and structural analysis. At the same time, the most successful experimental protocols will take advantage of minimal sample preparation, straightforward data collection, and unambiguous interpretation of results. In this talk, we present a broad overview of the rich chemical and structural information provided by both Raman and X-ray Photoelectron Spectroscopies, with an emphasis on applications that derive significant benefit from leveraging both techniques in a complementary fashion. While both XPS and Raman can be used to generate complex datasets using a variety of advanced sampling approaches, the real power lies in the user's ability to generate answers to challenging problems without the need for an in-depth understanding of the technique itself. Specific examples will be given that demonstrate how both approaches are essential to uncovering the fundamental science behind functionalization of thin graphene films, characterization of one-dimensional carbon materials, and other applications -- allowing anyone to quickly develop expertise in new and emerging fields.

12:40pm **EW-TuL3 Multi-Dimensional XPS Profiling from Thermo Fisher Scientific**, ***A. Bushell***, *R.G. White, T.S. Nunney, P. Mack, A.E. Wright*, Thermo Fisher Scientific, UK

X-ray Photoelectron Spectroscopy (XPS) provides crucial surface specific chemistry information when evaluating any surface modification, thin film coating or the composition of electronic devices. Depth information from inorganic materials can be obtained by removing material by use of Ar ion sputtering, but organic material can be adversely affected by this process. More recently, noble gas cluster ion beam sources have been developed for profiling of organic materials. The development of a combined monatomic and gas cluster ion source (MAGCIS) allows for a single depth profile experiment to have both cluster and monatomic etching stages. This is ideal for the depth profiling of devices and structures with mixed inorganic and organic layers.

When dealing with the analysis of small features, such as bond pads and tracks for electronic devices, Parallel Imaging XPS provides unmatched spatial resolution for XPS analysis. Reconstructing a spectrum from a chosen area on a spectroscopic parallel XPS image gives the analyst absolute confidence in the area from which that spectrum was obtained. The combination of retrospective spectroscopy from image stacks with a depth profiling capability within a single experiment gives the surface scientist a valuable tool for parallel multi-point depth profile analysis. Processing the large multi-dimensional data sets produced from such experiments requires a sophisticated range of statistical analysis tools, provided within the *Avantage* software.

This presentation will provide examples of data acquired from the Thermo Scientific XPS product range, demonstrating the above capabilities.

1:00pm **EW-TuL4 Organic Depth Profiling using XPS – Pro's and Con's of Different Polyatomic Species**, ***C. Blomfield***, *S. Hutton,* Kratos Analytical Ltd, UK*, D. Surman*, Kratos Analytical Inc.

XPS depth profiling of organic materials while retaining chemical information has traditionally been problematic. The advent of polyatomic ion species for sputtering has substantially changed the way depth profiling can be carried out. A variety of ion species have been developed such as C60, Coronene and Ar clusters all of which seem to have particular areas (types of materials) that they are suited to. This presentation discusses several of these ion species and what their advantages and disadvantages are and how they can be applied. Examples will be shown ranging from polymers to organic PV materials as well as some inorganic materials.

1:20pm **EW-TuL5 What's New from Physical Electronics**, ***J.F. Moulder***, Physical Electronics

The latest innovations in XPS, AES, and TOF-SIMS instrumentation from Physical Electronics will be presented.

1:40pm **EW-TuL6 KolibriSensor and Tyto: New Milestones in Scanning Probe Microscopy**, *T. Hänke, Y. Dedkov, A. Pioda, T. Kampen,* ***A. Thissen***, SPECS Surface Nano Analysis GmbH, Germany

The KolibriSensor™ from SPECS represents a new quartz sensor on the market that excels in its performance and its reliability. It is based on a symmetrical length extension resonator. The high resonance frequency of 1 MHz and the good signal-to-noise ratio allows for faster data acquisition in scanning microscopy and force spectroscopy. Oscillation amplitudes may be set below 20 pm. High stiffness prevents snap-in and the low noise floor continues to give a good frequency shift signal. The tip of the KolibriSensor™ has a separate contact, guaranteeing clean separation of the signals from the tunneling tip and from the quartz force sensor. The new Tyto scan head from SPECS is a milestone in the technology of Scanning Probe Microscopy. The modular design allows for various experimental configurations and for the usage of different sensors. A kinematic mount is used for both the sample and sensor and this feature is combined with accurate position sensors. For the first time, this enables different sensors to access identical locations on a sample and to repeat the procedure after successive sample preparation steps. This opens up opportunities for new experiments and will advance the research of surfaces at the nanometer scale. Additional features of the Tyto scan head are: Four openings for in-situ evaporation, two specular ports for simultaneous optical experiments, and large front openings and windows situated on each side of the body and at the back for broad visual inspection of the sample and sensor. Various sample receptors can be installed in the Tyto scan head, with four or twelve electronic contacts to the sample. Optional extra features include a calibrated Cernox temperature sensor located directly under the sample plate, and a small heater to control the sample temperature to within 1 mK.

Exhibitor Technology Spotlight
Room: West Hall - Session EW-TuA

Exhibitor Technology Spotlight
Moderator: D. Surman, Kratos Analytical Inc.

3:20pm **EW-TuA5 NEG Pumps Improving the Performance of Vacuum Systems**, ***B. Garcia***, *E. Maccallini, P. Manini*, SAES Getters

The presentation will include a discussion of new and existing products and how NEG pump technology improves over all vacuum performance. The positive effect NEG Pump technology has on the bakeout process will be discussed as well.. Examples and data will be provided to support the discussion.

3:40pm **EW-TuA6 New Developments in Thin Film Deposition from Kurt J. Lesker Company®**, ***S. Armstrong***, *D. Bingaman*, Kurt J. Lesker Company

In this spotlight the Kurt J. Lesker Company will update the industry on some of its new thin film deposition solutions.

Exhibitor Technology Spotlight
Room: West Hall - Session EW-WeM

Exhibitor Technology Spotlight
Moderator: D. Surman, Kratos Analytical Inc.

10:20am **EW-WeM8 Mass Spectrometer Now Supports Process Control**, ***S. Lass***, Brooks Automation

With the introduction of the 835 Vacuum Quality Monitor and 835 Differential Pumping System, Granville-Phillips has added key control features and extended the operating pressure range to enable process monitoring and control. Driving outputs from user-defined equations which utilize the partial pressures from this gas analysis system provides the ability to start and stop a process based on specific conditions. And differential pumping allows operation at both process and base-out pressures. Process pressure operation together with the features required for process control will be covered.

Wednesday Lunch, October 31, 2012

Exhibitor Technology Spotlight
Room: West Hall - Session EW-WeL

Exhibitor Technology Spotlight
Moderator: D. Surman, Kratos Analytical Inc.

12:00pm **EW-WeL1 Nanoparticle Coating Technology for Vacuum Deposition**, *A.H. Kean, S. Saranu,* ***M. Green****, L. Allers*, Mantis Deposition Ltd., UK

In-vacuum generation and deposition of nanoparticles can provide enhancement to traditional thin film deposition techniques. Traditional thin film deposition in vacuum utilizes an evaporation, or sputter process that forms a two dimensional thin film. The Mantis Deposition Nanogen provides three dimensional nanoparticle crystals that are formed via a high pressure sputtering process. Through the process, the nanoparticles are thermalized, charged, and deposited on the substrate via a controlled beam. The resulting coating is a not a traditional thin film, but a three dimensional material consisting of deposited nanoparticles. Significant differences in the properties of these materials arise including greatly increased surface area and increased chemical reactivity. Because the nanoparticles are charged they can be measured and their kinetic energy may be controlled. This talk describes the technique as well as resulting material properties. Specific examples will be described as well as new nanoparticle structures such as core/shell materials enabled by this advanced technique.

12:20pm **EW-WeL2 Using the Ipad in PVD Applications**, ***C. Malocsay***, Semicore

It has taken 30 years for computer control to become a main stay in the operational architecture of Thin Film deposition systems. Now with that hurdle gone, using some of today's new tablet devices in conjunction with the system PC can provide a complete array of documents, schematics, video including direct communication with the factory engineer. Insuring day to day process performance remains consistent and cost effective; the Apple iPad is just another example of Semicore leading the way.

12:40pm **EW-WeL3 Physics-based Simulation for Semiconductor Processing Optimization**, *K. Jain,* ***N. Solanki***, ESI Group

ESI Group is a global supplier of end-to-end virtual prototyping software and solutions, incorporating the physics of materials for manufacturing industries. The presentation will focus on computation fluid dynamics (CFD) modeling in the semiconductor fabrication process. Semiconductor fabrication processes involve a complex interplay of physical and chemical phenomena at multiple time and length scales. The complexity of these processes is increasing with decreasing feature size. Understanding these processes is critical for achieving desirable feature characteristics. ACE Suite, from ESI Group, is a commercial CFD software that provides integrated simulation tools for analyzing a wide variety of semiconductor reactors, ranging from CVD to Electroplating reactors. The ACE Suite also includes a topological solver, CFD-TOPO, that allows designers to accurately predict the 3D shape evolution of the feature at micron level. Our presentation will include the key features and benefits of our software along with a few selected validation studies.

1:00pm **EW-WeL4 Passive Thermal Actuator**, ***I. Miller***, MEWASA North America, Inc.

General Description: The PTA™ (Passive Thermal Actuator) developed and manufactured by MEWASA A Swiss Manufacturing Company) is a self-operating device that changes its length according to temperature fluctuations and serves as a linear actuator in various applications. The metal Passive Thermal Actuator is designed for various specified temperature ranges and allows the user to design Mechanical, Cryogenic and Electro-optical systems with precise movement as required. The PTA™ unique sturdy construction design provides a maintenance free linear movement with an extremely high reliability. The PTA™ is designed for more than 1 million operational cycles. Principle Operation: The PTA™ is a stainless steel sealed welded metal construction is based on the precision Edge Welded Bellows that are designed and Manufactured by MEWASA. The sealed actuator is filled with thermal fluid which expands and retracts according to the fluid/environment temperature changes. Thus, generating precise repeatable linear movement; pushing and pulling the required mechanism under a specified load. The Expansion Rate (defined as the fractional change in length per degree change in temperature) is customized and tested at MEWASA's in-house laboratory per our rigid Q.A. standards prior to shipment. The PTA™ is designed to move within several microns (thousands of an inch) and will work in any temperature range between –40°c and +80ºc (-40°F to 176°F). This cost effective PTA™ is a leak tight actuator which maintains its repeatability in a wide range of temperatures and pressures. The PTA™ frictionless structure and compact design functions as the ultimate solution for systems where external power is undeliverable. The Passive Thermal Actuator designed and manufactured by MEWASA is capable to meet your parameters. Product Features: • Highly accurate linear movement in a wide range of temperatures and pressures. • Eliminates the need for external power. • Maintenance free operation – no elastomeric seals required. • Flexible design that can be installed in either horizontal or vertical orientation. • Hermetically sealed and environmentally protected. • Complete stainless steel construction to resist corrosion. • Frictionless operation. • Designed to customer specific functional needs • No calibration required – preset at factory (plug and play). • Designed to deliver extremely precise and highly repeatable linear activation. • Sizes: from Ø13mm (Ø ½") • Materials: St.St. 316, AM350, Titanium Gr. 2, Inconel, Hastelloy C-276. (Note: material selection should take into account the environment and application) • Available Lengths: From 12mm (½") according to design • End Piece Standards: Threads, flanges to fit customer design • Installation Position: Vertical or Horizontal • Thermal Expansion Coefficient: from 0.01mm/°C (0.0008"/°F) • Actuation Force: from 1kg (2.2 lb.)

1:20pm **EW-WeL5 Bipolar Technoloogy for AZO Sputtering**, *P. Ozimek,* ***W. Głazek****, K. Ruda, A. Klimczak, A. Gierałtowski*, HUETTINGER Electronic Sp. z o.o., Poland

Bipolar technology is currently being implemented in progressing number of applications like sputtering and PECVD. Thanks to state of the art digital control platform, TruPlasma Bipolar NEW power supply has an ability to react to dynamically changing parameters of the process very fast in order to enhance process efficiency and repeatability. The new opportunities offered by such control electronics enables new features supporting reactive sputtering with Bipolar technology. Presented solutions enable to deposit coatings with enhanced quality and at high deposition rate. Moreover TruPlasma Bipolar series 4000 NEW in response to growing market demand is equipped with latest industrial communication protocols like EtherCat or internet IP. TruPlasma Bipolar NEW is a solution for PECVD and a wide range of sputtering applications. TruPlasma Bipolar can be used with materials like: AZO, Si, SiN, Zn also smooth operation with capacitive and inductive loads under both: symmetrical as well as non symmetrical load conditions.

1:40pm **EW-WeL6 Novel Dual Mode Air Photoemission and Kelvin Probe System for Work Function Analysis of Nanometer Films**, ***I.D. Baikie***, KP Technology, UK

KP Technology have developed a novel surface characterization instrument – the Air Photoemission System (APS) – which yields information on both the absolute work function and the Density Of States (DOS) near the Fermi level of metals and semiconductors deposited as bulk, thin films, layers, devices etc. The new system uses low photon excitation energies (3.5 – 7.0eV)

and has been used to characterize thin films such as Cobalt-Phylocyanine (CoPc) on Transparent Conducting Oxides (TCOs) used in electroluminescent displays. We have combined this technique with our ultra-high relative work function resolution (1 – 3meV) macroscopic scanning Kelvin Probe Systems and can build up 2D work function maps of surfaces with lateral resolution of 100 – 2000mm.

The work function is an extremely surface-sensitive property of a material, modified by thin or monomolecular adsorbed layers, surface charging and for semiconductors, illumination. Indeed, work function changes of 500 - 1000meV magnitude can be observed with nanometer thick films deposited on glass, TCOs, metals and semiconductors. Our Kelvin Probe systems are also extremely versatile, capable of automatic work function/Fermi-level monitoring operating in ambient, controlled atmosphere (nitrogen, humidity) and using a custom head unit, UHV over a wide temperature range (4 – 1000K). Using a 1.24 – 3.1eV monochromatic light source, SKP can be extended to provide Surface Photovoltage Spectroscopy (SPS) which is an ideal tool for surface characterization of organic semiconductors and solar cells, allowing clarification of the energy band diagram and adsorption phenomena. This presentation will provide illustrative data on materials such as wide bandgap semiconductors (ITO), TCOs (TiN, TiO_2), nanometer thickness films and OLEDs.

Exhibitor Technology Spotlight
Room: West Hall - Session EW-WeA

Exhibitor Technology Spotlight
Moderator: D. Surman, Kratos Analytical Inc.

3:20pm **EW-WeA5 Heidelberg Instruments microPG501, A Direct Write Lithography Tool**, ***N. Wijnaendts van Resandt***, Heidelberg Instruments

Heidelberg Instruments Presents the newest addition to its lineup of Direct Write Lithography tools. These tools are used for the production of photomasks as well as for direct write on substrates for MEMS, microfluidics, MicroTAS, micro optics and a wide variety of other applications where a lithographic process is required.

3:40pm **EW-WeA6 Dry Etching Enabling Surface Texturing for Thin Substrate Solar Cells**, ***R. Mohondro***, Plasma-Therm LLC

Solar energy implementation continues to advance towards grid parity through efforts to reduce costs and increase efficiency. Higher cell efficiency can result from many approaches. This work looks at the method of surface texturing to enhance light capture and reduce losses due to unwanted reflection. Although surface texturing of crystalline silicon has traditionally been achieved with wet (alkaline) chemistry, it faces limitations with thin wafers. Significant work is being done to reduce silicon material costs by reducing wafer thickness. Recent work has demonstrated wafers 10-15µm thick with 10x estimates of lower initial material costs. However, the desired efficiency improvements resulting from texturing are not possible with wet processing as the texturing thickness approaches or exceeds that of the wafer thickness. In this work we present enabling dry etching technology that offers efficiency enhancing texturing compatible with very thin wafers. Limiting the material removed to approximately 1µm eliminates surface damage while maintaining the structural integrity of the thin wafer and generating the required anti-reflection morphology. Dry etching process data showing controlled adjustment of the textured surface and the impact on reflectivity will be discussed along with the challenges of handling these extremely thin substrates.

Thursday Lunch, November 1, 2012

Exhibitor Technology Spotlight
Room: West Hall - Session EW-ThL

Exhibitor Technology Spotlight
Moderator: D. Surman, Kratos Analytical Inc.

12:00pm **EW-ThL1 EW Multi Vendor Presentation: Kratos/PHI/Thermo/Omicron**

Authors Index

Bold page numbers indicate the presenter