Tuesday Morning, November 10, 2009

Exhibitor Workshops
Room: Exhibit Hall 1 - Session EW-TuM

Exhibitor Workshop
Moderator: B.R. Rogers, Vanderbilt University

10:20am **EW-TuM8 A New Ion-Trap based Vacuum Quality Monitoring & Measurement System**, ***K. Van Antwerp***, *G.A. Brucker, J. Rathbone, S. Blouch, M. Schott*, Brooks Automation, Inc.

Granville-Phillips, a Brooks Automation Product Line, is introducing the Series 850 VQM vacuum quality monitoring and measurement system for 1-300amu mass range applications that is comprised of a high speed Total and Partial Pressure Ionization Gauge Sensor and High Performance Vacuum Gauge Controller. Vacuum Quality Measurement (VQM) requires the ability to measure both total and partial pressures and is linked to yield, throughput and uptime improvements in vacuum applications. The ideal VQM system must offer real-time information, should be easy-to-use and calibrate, must offer uninterrupted operation, and seamless data analysis and information delivery. The Series 850 VQM provides these features with 100amu range VQM measurements in 100ms for new visibility into the gas-specific components of a vacuum system pressure burst, high-speed leak and gas-specific monitoring and detection, no zero-blast accurate hydrogen and helium measurements, and VQM driven real-time analog, digital and setpoint relay outputs. The Series 850 VQM gauge can be easily mounted to the vacuum system by remote cable connection to the Vacuum Gauge Controller and calibrated using an automated single gas calibration system. The Series 850 VQM has a graphics display for total and partial pressure measurements, gas specific trend display, and front panel operation. The Series 850 VQM supports instrument automation through Ethernet and USB interfaces and a full set of software tools.

Tuesday Lunch, November 10, 2009

Exhibitor Workshops
Room: Exhibit Hall 1 - Session EW-TuL

Exhibitor Workshop
Moderator: B.R. Rogers, Vanderbilt University

12:40pm **EW-TuL3 New Developments in Spectroscopic Imaging from Thermo Fisher Scientific**, ***R.G. White***, *A.E. Wright, J. Wolstenholme*, Thermo Fisher Scientific, UK

Surface structure and chemistry are crucial to the successful production and operation of innumerable devices, materials and coatings. X-ray photoelectron spectroscopy, with its high surface specificity and chemical state sensitivity, is an ideal tool for the evaluation of material composition. XPS spectroscopic imaging, in which spectral data are acquired with some degree of lateral resolution, allows the identification of both spatial and chemical variations in materials. The expansive data sets that result from spectroscopic imaging must be treated with powerful software algorithms, to extract high levels of spatial and chemical information with a minimum of acquisition time.

Spectroscopic imaging solutions to structural and chemical problems are presented using the full range of state-of-the-art fully integrated X-ray Photoelectron Spectrometers from Thermo Fisher Scientific. Such analyses demonstrate the importance of small-scale structure on the integrity of a polymer blend, show the consequences of corrosion/dissolution of metallic and polymeric surfaces, and illustrate the nature of bonding failures. The effectiveness of spectroscopic imaging analyses, and intensive, automated data refinement processes using award-winning Avantage datasystem, are shown for each of these examples.

1:00pm **EW-TuL4 State-of-the-Art Nanostructure Compositional Analysis with Scanning Auger Microscopy**, ***J.S. Hammond***, *D.F. Paul, J.F. Moulder*, Physical Electronics

Advances in nanotechnology research now require analytical techniques that can image the elemental and chemical compositions of novel three dimensional structures. To meet these needs, a new state-of-the art Scanning Auger Nanoprobe has been developed with high energy resolution chemical state spectroscopy combined with Auger imaging uniquely tailored to nanostructure morphologies. The instrument design will be briefly discussed and highlights from the analysis of several nanostructures structures will be reviewed.

1:20pm **EW-TuL5 State of the Art in XPS**, *C.J. Blomfield,* Kratos Analytical Ltd, UK, ***D.J. Surman***, Kratos Analytical

Modern XPS instruments such as the Axis range from Kratos Analytical offer a variety of analytical capabilities extending beyond simple chemical characterisation of the upmost layers of a material surface. Advances in ion gun technology, chemical imaging resolution, instrument spectroscopic performance and data processing have made analysis faster, data more accurate and the previously impossible possible. XPS is becoming more wide spread with new users from fields such as photovoltaics, biocompatibility, pharmaceuticals and nano-science enjoying the benefits of surface analysis.

More specifically; improvements in ion gun technology have meant low energy monatomic sources can give better interface quality for multi-layer inorganic materials. The development of polyatomic ion sources has made XPS depth profiling of organic materials feasible. XPS imaging has developed into a technique to quantitatively characterise surface inhomogeneity and the application of multivariate data analysis techniques has reduced acquisition times while improving information content. Angle resolved XPS has benefited from new interpretation routines via the application of maximum entropy analysis methods to extract meaningful, non destructive, concentration profiles over the first few nanometres.

This presentation aspires to give an overview of the state of the art in XPS driven surface analysis by presenting examples and case studies from a number of important application areas ranging from thin film photovoltaics to bio-compatibility. Examples where hardware and software advances have helped the analyst will be given for techniques such as auto quantification, XPS depth profiling, angle resolved XPS, chemical state imaging, work function determination and electronic structure characterisation.

Exhibitor Workshops
Room: Exhibit Hall 1 - Session EW-TuA

Exhibitor Workshop
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3:20pm **EW-TuA5 *Z*therm™ Modulated Thermal Analysis with Sub-Zeptoliter Resolution Using the Asylum Research Cypher and MFP-3D AFMs**, ***J. Li***, *R. Proksch*, Asylum Research

Asylum Research, the technology leader in Scanning Probe and Atomic Force Microscopy (SPM/AFM) will present the new *Z*therm Modulated Local Thermal Analysis Option for its MFP-3D™ and Cypher™ AFMs. *Z*therm provides highly localized heating with sensitivity to $\leq 10^{-22}$ liter (sub-zeptoliter) materials property changes, more than an order of magnitude improvement in volume over that previously available with commercial systems. A standing problem with existing AFM-based thermal analysis systems is thermally induced bending of the cantilever that results in spurious deflection signals and variable loads being applied during heating. Asylum has developed a patent-pending cantilever compensation and control solution that corrects this problem, providing constant-load detection of thermally induced melting (Tm), phase transitions (Tg) and other morphological and compliance effects for materials studies and material identification – for areas less than 20nm x 20nm. In addition to standard thermal analysis capabilities, the *Z*therm package can also be used to evaluate contact stiffness and dissipation as a function of temperature with advanced techniques such Dual AC Resonance Tracking (DART™). The contact stiffness and dissipation – measured at the cantilever resonance – are much more sensitive to temperature dependent properties, including surface melting and transition temperatures, than conventional deflection-based measurements. In addition, integrated piezo actuation allows high resolution AC imaging of samples for surface topographical mapping before and after thermal measurements.

3:40pm **EW-TuA6 Difference Raman for Enhancing Image Resolution by Accurate Tip Positioning of an Atomic Force Probe that Enhances or Shadows the Raman Signal**, *J. Ernstoff*, ***R. Dekhter***, *H. Taha*, *A. Israel*, *D. Lewis*, Nanonics Imaging Ltd., Israel, *A. Lewis*, Hebrew University of Jerusalem, Israel

Tip enhanced Raman scattering (TERS) has been shown as a potential technique for overcoming limitations of conventional micro Raman spatial resolution and for other apertureless near-field optical measurements based on plasmonic interactions. In this talk we will compare the resolutions obtainable by such plasmonic enhancement techniques as compared to a method we have developed based on the ultra-sensitive nature of difference Raman. In this latter technique an AFM probe with an exposed tip geometry that is optimized to block a nanometric region of a sample will be used in conjunction with difference Raman to obtain significant improvements in Raman image resolution over conventional far-field scattering. For this new imaging protocol one has to have not only exposed tip geometries but also an AFM system that can modulate and scan the probe independently of the sample scanning required for Raman imaging systems. The tip scanning is required for optimizing the position of the probe tip for maximizing the shadow effect on the sample in the near-field. The independent tip movement is required for bringing the probe in and out of the near-field of the sample so that a difference Raman can be recorded at each pixel and an image formed as the sample is scanned point by point. All of the above in terms of the Shadow protocol are predicated by having an AFM system that has a completely free optical axis from above and is completely independent from the lens of the micro-Raman. Results will be shown on structured thin films of strained silicon on silicon to show the relative fidelity of these imaging modalities. The results indicate that Shadow Near Field Scanning Optical Microscopy (sNSOM) is a powerful technique that can be applied for significant improvements in Raman imaging spatial resolution.

Exhibitor Workshops
Room: Exhibit Hall 1 - Session EW-WeM

Exhibitor Workshop
Moderator: R.A. Langley, Consultant

10:20am **EW-WeM8 RJ Lee Group's Advanced FESEM/STEM and XPS Analytical Services for Exploring the Nano-World**, ***B.R. Strohmeier***, *K.L. Bunker*, *J.D. Piasecki*, RJ Lee Group, Inc.

RJ Lee Group, Inc. (RJLG, www.rjlg.com) is an organization of experts who provide the highest quality microscopy, analytical, and consulting services to our clients and partners. Leading organizations come to RJLG for more than data and information; they come for an innovative approach and technical solutions developed through our commitment to quality, reliability, and customer satisfaction. RJLG is presently the exclusive commercial analytical testing laboratory in the United States to offer analytical services with: 1) the Hitachi S-5500 electron microscope, which combines field emission scanning electron microscopy (FESEM) and low kV scanning transmission electron microscopy (STEM) with energy dispersive X-ray spectroscopy (EDS) and 2) the Thermo Fisher Scientific K-Alpha X-ray photoelectron spectroscopy (XPS) instrument. The S-5500 and K-Alpha are two of the most powerful materials and surface characterization instruments available to scientists today. This presentation will give a brief overview of the advanced capabilities of each instrument along with examples of applications of these instruments for the characterization of nanomaterials.

The highlight of the Hitachi S-5500 electron microscope is the cold field emission electron source and the in-lens technology, which together achieve the world's highest secondary electron imaging resolution of 0.4 nm at 30 kV. The electron optical design of the Hitachi S-5500 places the sample at the optimum analytical and imaging working distance, allowing concurrent acquisition of high-resolution FESEM and STEM images, as well as EDS information. A variety of signals can be collected simultaneously including secondary electron and backscattered electron FESEM images and bright field (BF) and dark field (DF) STEM images. Combining this instrument with new silicon drift detector (SDD) technology (Bruker 30 mm^2) allows for high resolution elemental analysis and mapping of nanostructures. Therefore, the S-5500 can obtain unique information on samples that single standard microscopy techniques, such as SEM and TEM, are not able to accomplish when used alone.

XPS is a highly surface-sensitive and quantitative technique for materials characterization. The Thermo Fisher Scientific Model K-Alpha XPS is a compact, fully integrated, state-of-the-art instrument, with many outstanding features such as: 1) a high intensity, monochromatic, Al Kα X-ray source with an analytical spot size that can be easily varied from 30-400 µm, 2) a high transmission, high spectral resolution, electron energy analyzer, 3) a high sensitivity multi-channel detector, 4) a versatile sample stage capable of handling large or multiple samples with various sample mounting options, 5) *in situ* optical sample viewing and positioning, 6) elemental and chemical state surface mapping capability, 7) high quality depth profiling performance, 8) an unprecedented, highly automated, operation intended for non-expert and multi-user environments, and 8) advanced data processing software. Nanometer scale sampling depth and its ability to provide chemical state information makes XPS an ideal analytical technique for investigating the elemental and chemical surface composition of nanoparticles and other complex advanced materials.

Wednesday Lunch, November 11, 2009

Exhibitor Workshops
Room: Exhibit Hall 1 - Session EW-WeL

Exhibitor Workshop
Moderator: R.A. Langley, Consultant

12:40pm **EW-WeL3 Time and Phase Resolved Plasma Diagnostics for RF and Pulsed Plasma Applications**, ***M. Hopkins***, Impedans Ltd.

The deposition and etching of layers by plasma discharges operating in pulsed mode have many important applications. The variation of the time parameters of the process (frequency and duty cycle) lead to noticeable modifications of the deposited layers and the etch rate. Plasma diagnostic are now available to measure the change in plasma composition and this is turn is often correlated with the quality of the process. In diamond thin films the quality of films produced is strongly correlated with the concentration of H-atoms, CH and C2 radicals and their evolution during the discharge regime and the afterglow. Indeed, these species are well known either as agents for graphite etching (H), or diamond precursors (CHx imaged by CH) or graphite precursors (C2Hx imaged by C2). In silicon etching anomalous side wall etching, called 'notching' in gate poly-Si etching, is suppressed in pulsed-power chlorine inductively coupled plasma. In order to understand the complex mechanisms involved in pulsed or indeed RF plasma a comprehensive suite of time and phase resolved measurements have been developed by Impedans. In this presentation we will show dependent measurements of ion energy distribution, plasma potential, electron and ion density/flux and electron temperature data in pulsed and RF plasma illustrating the complex changes occurring when time modulation is used in plasma processes.

1:00pm **EW-WeL4 Modern e-Gun Evaporation Simplified for Research and Pilot Production Applications**, ***J. Moore***, *M. Ricks*, Thermionics Vacuum Products

Over the past 50 years electron beam sources have gone through numerous transformations. As the vacuum coating industry has evolved, electron guns have advanced from simple permanent magnet sources to sources with advanced magnetics and electromagnetic sweeping to meet the numerous application needs.

In the late 1980's, Thermionics' HM2 sources introduced discrete modular magnet technology which allowed beam shapes to be optimally configured for a process. This also provided a mechanism for advancing co-deposition making possible a source that could evaporate 6 materials simultaneously with complete independent control while maintaining extremely close crucible locations. The introduction of high frequency beam sweep helped to further increase the uniformity of the e-beam temperature making the sources more reliable

Modern sources such as the Thermionics' RC and HC e-Guns utilize traditional magnets with a series of modified pole extensions to create the effect of a discrete modular magnet source while still providing a "simple to service" source. Other features such as dual filament emitter assemblies and plug in emitter modules allow a high level of performance with minimum maintenance and technical expertise. This new generation of sources blend the past function oriented source with the modern high performance source allowing the average graduate student or research scientist access to the full spectrum of e-gun evaporation.

While sources have evolved, system technology has also been steadily moving forward. New systems incorporate hinged quick access doors and fully automated computer controls. Thermionics latest machine tools go one step further with cartridge loaded sources and sample holders. This new level of flexibility allows a research group to change process recipes in just minutes.

1:20pm **EW-WeL5 Modeling Electron Impact Collisions of Gas Mixtures Using Particle-in-Cell (PIC) Code**, ***S. Mahalingam***, *S. Veitzer*, *P.H. Stoltz*, Tech-X Corporation

We are developing a Monte Carlo Collision (MCC) model in VORPAL, a three-dimensional particle-in-Cell (PIC) plasma simulation code that will self-consistently model various types of electron impact collisions with a neutral gas (or) a combination of gas mixtures. The MCC model will include elastic (such as elastic scattering, and large-angle elastic scattering), inelastic (such as excitation, and ionization) and Bremsstrahlung collisions. A null collision technique is used for handling the electron impact collisions. The collision cross sections data are based on the Evaluated Electron Data Library (EEDL) dataset, which we obtained from the International Atomic Energy Agency Nuclear Data Services (IAEA NDS). The EEDL library contains collision cross sections and generation data for electrons and photons for atoms with Z = 1 – 100 for incident electron energies from 10 eV (or threshold) to 100 GeV. Additionally, we will enable the elastic scattering cross section data available for low incident electron energies (below 10 eV) from known measurements, so that the MCC model can be applied for studying the low temperature plasma problems. Users also have the option of specifying a user-defined model of the cross section. We will show simulation results for gases and parameters relevant to the plasma processes involved in the breakdown of metallic structures occurring in high-gradient RF cavity experiments.

*The work of Tech-X personnel is funded by the U. S. Department of Energy under Small Business Innovation Research (SBIR) Contract No. DE-FG02-07ER84833.

1:40pm **EW-WeL6 Near Ambient Pressure XPS - In Situ Surface Analysis Under Extreme Conditions**, ***A. Thissen***, SPECS GmbH, Germany

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Bold page numbers indicate the presenter