Exhibitor Technology Spotlight Workshops
Room Exhibit Halls A-B Booth 1003 - Session EW-TuL

Exhibitor Technology Spotlight Session I

Moderator: Christopher Moffitt, Kratos Analytical Inc

12:00pm **EW-TuL-1 Challenges and Solutions for Ion Energy and Ion Flux Measurements in Plasma-Assisted Etching and Deposition Processes***, **Angus McCarter**,* Impedans

This work demonstrates the role of energetic ions in plasmas and how they affect the properties of materials etched or deposited in thin-film plasma processing. We will show how to use measured ion flux, ion energies and ion-neutral fractions to optimize industrial plasma-assisted processes. For this purpose, ion energy and ion flux measurements were carried out using fully automated advanced Retarding Field Energy Analyzers (RFEA's) by Impedans Ltd [1, 2]. The Semion RFEA measures the ion energies hitting a surface, the ion flux, negative ions and bias voltage at any position inside a plasma chamber using an array of integrated sensors. On the other hand, the Quantum system is an energy resolving gridded quartz crystal microbalance (QCM), used to measure the ion-neutral fraction hitting a surface inside a plasma reactor. This instrument also measures the etching/deposition rate, ion energy, ion flux and bias voltage.

Firstly, this talk will give general insights into how ions behave under different chamber and bias conditions. Then we will present a review of thin-film applications, particularly focusing on plasma-assisted Atomic Layer Deposition (ALD) and Atomic Layer Etching (ALE) processes is presented in detail [3-5]. This will include discussion on the impact of substrate biasing on the ion energy distribution (IED), impact of ion impingement on the chemical and microstructural properties of thin-films. The continuously decreasing feature sizes and aspect ratio dependent profiles need special techniques to control precisely the ion energies and flux of ions and neutrals responsible for the undergoing process. Pulsing the source and/or the bias voltages, or applying tailored voltage waveforms as biases, are techniques used to control the ion bombardment energy as well as for precise ion energy control. We will highlight the successful measurements done by Semion in such applications enabling accurate and precise control of etching profiles on different materials and various plasma chemistries.

References

[1] Impedans Ltd, Dublin, Ireland [www.impedans.com]

[2] S. Sharma et al., Ph.D. Thesis, Dublin City University (2016)

[3] H. B. Profijt et al., J. Vac. Sci. Technol. A 31, 1 (2013)

[4] M. H Heyne et al., 2D Mater. 6, 035030 (2019)

[5] S. Karwal et al., Plasma Chemistry and Plasma Processing 40, 697–712 (2020)

12:20pm **EW-TuL-2 Advance in Momentum Microscopy with NanoESCA MARIS***, **Marten Patt**, N. Weber, M. Escher, T. Kühn,* FOCUS GmbH, Germany

Since its introduction in 2005, the energy-filtered photoelectron microscope NanoESCA [1,2] has been used for various application including work-function mapping, imaging XPS and in the last years more prominently for imaging the reciprocal space, i.e., momentum microscopy or orbital tomography (e.g., at the NanoESCA at synchrotron Elettra, Trieste [3]).

The latest revision of the analyzer, called NanoESCA MARIS, has a new microscope lens. It was designed to achieve a better angular / momentum resolution while keeping the same good real space resolution < 35 nm from its predecessor. In momentum space mode, the instrument achieves a resolution of 0.005 $Å^{-1}$. We will show the performance on the Rashba split surface state of a Au (111) single crystal.

In addition, new working modes, like off-axis zoom, double dispersive imaging mode and an energy dispersion snapshot mode were introduced with the new analyzer and will be presented. Developments in the Imaging Spin Filter for NanoESCA [4] will be discussed.

References

[1]M. Escher et al., J. Phys. Cond. Matter **17** (2005)

[2]B. Krömker et al., Rev. Sci. Instrum. **79** (2008)

[3]M. Wießner et al., Nature Comm. **5**(2014) 4156

[4]M. Escher et al., Ultramicroscopy **253** (2023) 113814

12:40pm **EW-TuL-3 New Developments for Surface Analysis from Thermo Fisher Scientific***, **Adam Bushell**, T. Nunney, P. Mack, R. Simpson, H. Tseng,* Thermo Fisher Scientific, UK

In this presentation we will present the latest innovations in instrumentation for Surface analysis and materials analysis from Thermo Fisher Scientific.

1:00pm **EW-TuL-4 Driving Discoveries Through Surface Analysis***, J. Mann, **Greg Fisher**,* Physical Electronics

Physical Electronics (PHI) is the only manufacturer offering surface analysis products for all three main analytical techniques – X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES) and time-of-flight secondary ion mass spectrometry (TOF-SIMS). This presentation will discuss recent developments in TOF-SIMS and XPS, including the power of artificial intelligence for fast and reliable identification of species, unattended analysis for high throughput, and combining photoemission spectra from different analysis depths for thin film analysis.Our fully automated XPS system offers unprecedented value not found in conventional XPS instruments, by using multiple techniques covering a full range of energy - from conduction band with low energy inverse photoemission spectroscopy (LEIPS) to core-level excitation with hard X-ray photoelectron spectroscopy (HAXPES). The PHI TOF-SIMS instruments are optimized for the highest sensitivity elemental and molecular analysis, allowing detection of species in the ppm range. Our scanning AES instrument is optimized for high magnification chemical imaging and has increased versatility with multiple optional technique add-ons and accessories for specialized experiments.

1:20pm **EW-TuL-5 EnrivoMETROS – Advanced Surface Hybrid Metrology***, **Stefan Böttcher**,* SPECS Surface Nano Analysis GmbH, Germany

The SPECS EnviroMETROS is a new generation hybrid surface metrology system for precise surface analysis and quantification. The correct stoichiometric, chemical and dimensional analysis of surfaces and layered materials is a highly relevant task in modern device development and fabrication. In addition, information on electronic properties provides a comprehensive picture of the sample under investigation. We present the latest technological advances in tool design and discuss key applications in scientific and industrial environments, focusing on correct layer analysis, electronic structure analysis for semiconductor characterization, and handling of technologically relevant sample formats under various conditions.

1:40pm **EW-TuL-6 Kratos Axis Supra+ -- Automated, Quantitative HAXPES for Advanced Materials Development***, **Chris Moffitt**,* Kratos Analytical Inc.

The automation of modern instrumentation allows for broader access to more robust analysis over larger sample sets with advanced approaches.Kratos Axis Supra+ incorporates automated sample handling with automated analysis of XPS, UPS, depth profiling and others, including higher energy Ag-Lα generated, quantitative HAXPES, for increased depth analysis.

The Axis Supra+ allows more samples to be analyzed with the full capabilities of the highest-performing XPS instrument, without intervention.Once samples are physically loaded, analyses are submitted through the computer interface, utilizing multiple cameras for location identification, which can be done remotely.This follows on for utilizing the HAXPES mono source, so that analysis by standard Al-Ka monochromatic x-rays can be automatically followed by analysis with the higher energy Ag-La monochromatic source and the results automatically processed and quantified using new Data Dependent Acquisition software features.

The Axis Supra+ is uncompromised in its ability to analyze the wide range of new advanced materials, including operando surface analysis measurement of battery materials while biasing or flowing current and heating.The multi-contact stage in the Axis Supra$^+$ spectrometer accommodates the specialized holders for the operando analysis, supplying 4 electrical contacts to be used for these analyses, while still accepting all the standard sample platens for high throughput analysis.An inert sample transfer version of these multi-contact holders has also been developed, which allows the sample to be loaded and electrical connections made in a glove box and then loaded into the spectrometer without exposure to atmosphere.

Soft materials analysis has greatly expanded in the last several years since the introduction of argon gas cluster ion sources (GCIS), with the Kratos

dual mode cluster source also able to perform traditional monoatomic argon profiling of hard inorganic materials.The cluster mode is able to profile light ion materials without the artifacts inherent in monoatomic sputter-etching of these materials.

Additional analytical techniques, such as Ag-Lα HAXPES, ISS, UPS, AES, REELS and IPES are all possible on the Supra$^+$, and additional sample preparation chambers can be easily added, such as a station for deposition or the high-pressure, high-temperature gas reaction cell for catalysis experiments and measurement.

2:00pm **EW-TuL-7 VON ARDENNE: Shaping the Future of Coating Technologies to tackle Today's Challenges in Global Industries***, **Daniel Radach**, B. Coll, B. Cohen, J. Rajan, P. Burke,* VON ARDENNE North America, Inc.

Since its inception in 1928, VON ARDENNE has grown into the world-renowned VON ARDENNE Group. As a family-owned entity headquartered in Dresden, Germany, the organization boasts a vast global footprint spanning more than 50 countries and harnessing the talents of over 1,000 dedicated employees. With a remarkable portfolio of over 650 patents worldwide, the company's innovative prowess has led to the successful installation of over 550 advanced coating systems worldwide.

VON ARDENNE's unique coating skills are at the forefront of tackling pressing global challenges, within energy, mobility, and connectivity sectors. The company's innovative capabilities extend to diverse industries, from solar cells and modules to smart glass and touch screens, batteries, fuel cells and electrolysis systems, and even the aerospace industry with turbine blade coating requirements.
VON ARDENNE's success is based on key technologies perfected over half a century. These include expertise in electron beam and vacuum coating processes, encompassing magnetron sputtering, double rotary magnetrons, high-power electron beam guns, and thermal evaporation technologies. These capabilities translate into a comprehensive range of equipment, designed to meet a variety of needs – from small-scale laboratory tools for R&D, to medium-sized pilot tools, to large-scale mass production systems with very high throughput. We have acquired excellent process know-how based on the numerous coating systems which we have installed over the years.
VON ARDENNE's global activities are supported by a strong network of engineering, production, sales, and service centers located in key regions such as North America, Japan, China, India, Malaysia, Vietnam, and the company's German headquarters. The company's strengths include the ability to provide customized solutions ('Engineering to Order'), comprehensive qualification and ramp-up support, scalability and reproducibility, and a strong global service network. Concrete case studies illustrating VON ARDENNE's solutions, particularly in the field of crystalline silicon and thin-film photovoltaic cell technologies, highlight the company's technical skills, adaptability, and unwavering commitment to serving its global customer base with state-of-the-art high productivity and low Cost of Ownership (CoO) solutions.

As VON ARDENNE's legacy continues to fuel innovative breakthroughs in vacuum, plasma, sputtering and electron beam technologies, the company stands as a catalyst for significant contributions to global industries, ready to tackle the challenges of a rapidly changing world.

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