## Exhibitor Technology Spotlight
## Room Hall C - Session EW-TuM

### Exhibitor Technology Spotlight Session

**Moderator:** Chris Moffitt, Kratos Analytical Limited

10:20am **EW-TuM8 Toxic, Flammable and Corrosive Waste Gas Treatment. Protect your Employees and Environment***, D.K. Prasad,* CS CLEAN SYSTEMS, Inc.

Many of the semiconductor processes generate exhaust gases that are highly dangerous to Environment, Health and Safety. Novasafe is a reliable, proven and cost effective solution to allow the handling of toxic, flammable and corrosive waste gas exhaust. Learn more about this product solution in the Spotlight presentation by CS Clean Solutions Air pollution regulations, employee health concerns and growing awareness of toxic agents from semiconductor, industrial and research facilities demand improvements in exhaust gas conditioning. The NOVASAFE dry scrubber reduces the hazards associated with pyrophoric, toxic and corrosive gases and vapors. NOVASAFE effluent gas scrubbers offer an extremely safe and efficient way to treat such process exhausts. The scrubber is a technologically advanced device, containing approximately 10 liters of granulate scrubbing media specific to the process chemistry, and can be used in both production and laboratory and research environments. Operating passively at room temperature, the granulate material reacts on contact with process gases and chemically converts them to non-volatile inorganic solids. NOVASAFE, with its compact form factor, can be integrated with your vacuum pump system to provide a minimal footprint solution. Effluent is abated to sub-TLV levels. The NOVASAFE requires no preventative maintenance, and is replaced and disposed of at its end of life. Granulate is available for many different chemistries, including hydrides, acid gases, metalorganics, etc. making NOVASAFE a cost-effective solution for etch, MOCVD, ALD, ion implant and many other applications.

## Exhibitor Technology Spotlight
## Room Hall C - Session EW-TuL

### Exhibitor Technology Spotlight Session

**Moderator:** Chris Moffitt, Kratos Analytical Limited

12:40pm **EW-TuL2 Spin-resolved Momentum Microscopy***, Thomas Stempel Pereira,* SPECS Surface Nano Analysis GmbH

We present a newly developed lens design which provides a full 2π solid acceptance angle with highest angular, energy and lateral resolution. In contrast to standard electron analyzers, electronic structure data from and beyond the 1st Brillouin zone is recorded without any sample movement. In addition the lens can work in a lateral imaging mode for microscopy as well. This enables navigation on the sample and reduces the size of the area under investigation down to a few micrometers in diameter. We have combined this lens design with two different kinds of energy dispersive elements: a time-of-flight section or a hemisphere. Both versions combine large acceptance angle, high angular resolution and small acceptance area, making these instruments the ideal tools for electronic structure studies on small samples or sample areas. The functionality of these instruments can be further enhanced by replacing the standard 2D-DLD detector with a spin-resolving imaging detector. The spin-resolved imaging is achieved by electron reflection at a W(100) spin-filter in the [010] azimuth at 45° reflection angle crystal prior to the 2D detector. Varying the scattering energy one can choose positive, negative, or vanishing reflection asymmetry.

1:00pm **EW-TuL3 The New Generation of the Hemispherical Energy Analyser in the Novel Surface Science Research***, Lukasz Walczak,* PREVAC Sp z o.o., Rogow, Poland

The complexity and the range of materials and their surfaces studied will be expanded across a wide range of topics, including surface science, catalysis, corrosion, semiconductors research, photoelectrochemical energy conversion, battery technology, or energy-saving technologies [1-5]. An unique and exceedingly flexible analysis cluster with a detection system is needed for these fundamental and applied research. Here it will be described a new energy and angle resolved analyser for photoelectron spectroscopy. The analyser has a hemisphere shape with a mean radius of 150 mm and is based on combining an advanced focusing electron lens system, which can be operated in different modes, transmission, spatial resolution or angular resolution. An angular resolution of better than 0.06° and spatial resolution 100 µm can be obtained. The spectrometer includes highly stable 6 kV power supply, where each independent voltage module achieves temperature stability below 0.5 ppm of the voltage span per degrees Celsius. The modern 2-D low noise CCD-MCP assembly with a noise level of < 0.01 cps/channel and a 70 fps fast camera are used. Fully automation and environmental software system make it a user-friendly tool for the conducted researches. The combination of the new generation hemispherical energy analyser with a liquid helium/nitrogen manipulators and modular PREVAC surface analysis system as part of multi-technique surface analysis systems will be presented, in order to permit complete characterization of the surface structure via XPS, UPS, ISS and APRES mapping. We will report the first results from this techniques, using analyser and induced by four interaction sources: X-ray, UV, electron or ion impact. Also the results of temperature dependent study on the metallic crystal will be presented. UV excited Xe5p spectra recorded in the gas phase show that the energy resolution is better than 3 meV at 2eV analyser pass energy. The application of the system will be shown on photovoltaic materials, graphene, or self-assembled organic monolayers of organic molecules. This analyser opens up new possibilities for angular/spatial resolved electron spectroscopy, band-mapping and other applications.

**References**

[1] S. Bengió, et. al, Surf. Sci. **646**, 126-131 (2016)

[2] B. Eren el. al, Science**29**, 475-478 (2016)

[3] Z. Duan et. al, J. of Solid St. Electrochem. **19**, 2265-2273 (2015)

[4] N. Tomaszewska et. al, Surf. Sci. **632**, 103-110 (2015)

[5] K. Samson el. al, ACS Catalysis, **4**, 373-374 (2014)

[6] Yi-Chun Lu et. al, Sci. Rep. **2**, 715 (2012)

1:20pm **EW-TuL4 Latest Developments in XPS and Related Methods from Kratos Analytical***, Chris Blomfield, J.D.P. Counsell, S.J. Coultas, S.C. Page,* Kratos Analytical Limited, UK*; C. Moffitt,* Kratos Analytical Limited

The Axis Supra is the latest generation of XPS instrument from Kratos Analytical. In addition to offering enhanced energy resolution and sensitivity for XPS, it has a 15µm small area spectroscopy capability and 1µm imaging. The instrument is designed to offer a high level of flexibility and can be fitted with a range of complimentary surface analysis techniques such as UPS, ISS, AES, along with an additional surface science station and a range of sample treatment capabilities. In addition to offering benchmark level performance, the instrument and ESCApe data system combine to offer a high throughput platform optimized for the multiuser environment of today's surface analysis laboratory. Samples may be pre-aligned and analyses predefined so that, when combined with the automated sample transfer capability, high levels of throughput can be achieved with unattended operation. Applications of high resolution imaging, multispectral imaging, gas cluster ion source and GCIS-UPS studies will be presented on a range of new materials to underline the leading capabilities of the Axis Supra.

1:40pm **EW-TuL5 What's New with Physical Electronics***, John Newman,* Physical Electronics USA

Learn about all the new advances with Physical Electronics.

## Exhibitor Technology Spotlight
## Room Hall C - Session EW-WeM

### Exhibitor Technology Spotlight Session

**Moderator:** Chris Moffitt, Kratos Analytical Limited

10:20am **EW-WeM8 From Surface Spectrometry to 3D Analysis - Latest Trends and Instrumentation for TOF-SIMS***, **Nathan Havercroft**,* ION-TOF USA*; R. Moellers, A. Pirkl,* ION-TOF GmbH, Germany

During the last 25 years IONTOF has continuously made significant development efforts to further improve the instrumentation for Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS) and related techniques. Some of the most recent achievements include in-situ sample preparation and tomography by FIB, enhancement of maximum count rates and dynamic range in conventional depth profiling of inorganic materials, the design of a TOF-SIMS / SPM combination instrument, as well as the integration of an Orbitrap™ mass spectrometer with unrivalled mass resolution and mass accuracy into the TOF.SIMS 5 instrument.

IONTOF's, new TOF.SIMS NCS instrument platform combines all the well-known options of our high-end TOF.SIMS 5 system with the possibility to perform in-situ SPM measurements. The sophisticated, large area SPM unit has a scan range of up to 80 x 80 $\mu m^2$ and is ideally suited to provide topographic information for SIMS measurements. Beside AFM, MFM, KPFM and multi-frequency modes it also supports a unique surface profiler mode which allows for fast measurements of large SIMS craters. The new piezo sample stage with submicron position accuracy ensures fast and precise movement between the TOF-SIMS and the SPM measurement position.

Depth profiling of organic materials, e.g. layer systems for optical and electronic devices, can be ideally performed using gas cluster ion beams (GCIB) in combination with TOF-SIMS. For optimum performance, a dual-beam approach is usually utilized, employing a lower energetic quasi DC sputter beam for material removal and a short-pulse small-spot analysis beam for optimal mass spectral and imaging performance.

However, molecular identification of unknown substances, e.g. contaminants, is usually hampered by constraints in mass resolution and mass accuracy of the TOF analyzer. Furthermore, ions generated in the sputter phase of the dual-beam experiment are lost for analysis. In order to overcome these limitations, a TOF / Orbitrap™ SIMS hybrid instrument has been developed in order to combine all advantages of a state-of-the-art TOF-SIMS with the mass spectrometry performance of a Q Exactive™ HF mass analyzer. The Q Exactive™ HF provides a mass resolution of more than 240,000 @ m = 200 u, <1 ppm mass accuracy, and full MS/MS capabilities for structural analysis of complex molecules. By utilizing these unique features, the SIMS analyst can make peak identifications with much greater confidence.

## Exhibitor Technology Spotlight
## Room Hall C - Session EW-WeL

### Exhibitor Technology Spotlight Session

**Moderator:** Chris Moffitt, Kratos Analytical Limited

1:00pm **EW-WeL3 Why Test Inks Cannot Tell the Full Truth About Surface Free Energy***, **Thomas Willers**, M. Jin,* KRUSS

There are a range of methods for activating the surface when treating materials before coating, bonding or printing. These include thermal or electrical methods, such as plasma, flame or corona treatment, and chemical treatment with oxidizing gases. Equally important are cleaning steps which remove hydrophobic substances from the surface. All these methods increase the surface free energy (SFE) and therefore improve wettability and adhesion. Norms such as DIN 55660 for coating materials and DIN EN 828 for adhesive processes specify contact angle measurement as the method for determining the SFE of surfaces and for checking an activating or cleaning pre-treatment process. In addition, these inks, which are intended to reflect the SFE based on liquids with set surface tension (SFT) are also frequently used. According to the ink test method, complete wetting always occurs when the values of he SFE of the solid and the SFT of the liquid are equal. Many scientific authors have refuted this wetting theory and have shown that only an analysis of the polar and dispersive interaction fractions of the SFE and the SFT provide a complete picture of the wetting process. Contact angle measurements, which take these interactions into account, and ink tests should accordingly lead to different evaluations of surfaces and therefore also to different assessments of the quality of a pre-treatment process. In the present study, we have compared SFE results from contact angle measurements with those from ink tests for 13 very different materials. We also carried out comparative measurements on three plasma-treated plastics. Both the small number of consistent results and the large number of deviations can be conclusively explained when we take the effect of polar and dispersive interactions into account. It appears that the SFE result of an ink test must be called into question for many samples. In this discussion, we also point out some advantages of the contact angle method in measurement practice.

1:20pm **EW-WeL4 A Vacuum Species Sensor using Remote Plasma Emission Spectroscopy for Direct Monitoring of Vacuum Processes***, **Joseph Brindley**, D. Benoit, V. Bellido-Gonzalez,* Gencoa Limited, UK

Some form of monitoring of the vacuum environment is essential for the efficient operation of any vacuum processes. This can be achieved through a variety of sensors; from simple total pressure sensors, to highly sensitive quadrupole mass spectrometers. In particular, residual gas analysis (RGA) can be performed with quadrupole mass spectrometers. Residual Gas Analysis allows for detection and identification of individual species within the vacuum. This can result higher process yields through faster troubleshooting, scrappage reduction through contamination detection, more efficient use of pumping time, or a more controlled vacuum environment. The limiting factor for Quadrupole RGAs is the pressure range over which they can operate. Above $1x10^{-4}$ mbar damage will occur to the sensor's filament – restricting its use above this pressure. To overcome this obstacle a differential pump can be used to bring the local pressure at the sensor down to the required range. However, this is a costly addition and spurious readings can be generated from the differential pump itself. An alternative residual gas monitoring sensor that operates directly at pressures above $1x10^{-4}$ has been built around plasma emission monitoring. A small "remote" plasma can be generated inside a sensor that is part of the main vacuum. Consequently, species that are present within the vacuum will become excited in the sensor's plasma, emitting light at certain wavelengths, which can then be used to identify the emitting species. Advances in miniature spectrometers in combination with advanced spectrum identification software has resulted in a robust, lower-cost, multi-purpose vacuum sensor. Presented are a number of examples of its use in monitoring a variety of vacuum conditions such as contaminant detection, water vapour outgassing, etching process monitoring, pump down analysis and reactive deposition control.

1:40pm **EW-WeL5 Raman Imaging of Samples with Complex surface Topographies Using Renishaw's inVia Qontor***, **Tim Prusnick**,* RENISHAW, INC.

Recent advancements in hardware and software have been made to enable micro-Raman focus to be maintained over large areas during data collection. These developments allow analysis of samples that in the past were impractical or even impossible because of variations in surface topography. With the addition of Renishaw's latest innovation, Live Track™ focus tracking technology, the inVia Qontor enables users to analyze samples with uneven, curved or rough surfaces.

2:00pm **EW-WeL6 Ampoules and Bubblers 101***, **William Kimmerle**, K.S. Kimmerle,* NSI

NSI Bubblers and Ampoules are commonly used in Atomic Layer Deposition, Chemical Vapor Deposition, Epitaxial growth on crystalline substrates and numerous other applications. The drive for smaller structures continues to demand new materials and molecules as well as methods for depositing these new materials. Bubblers and ampoules provide a means of safely transporting and precisely delivering these new molecules to wafer substrates. Additionally, as higher vapor pressure materials are utilized, temperature control and ampoule content monitoring become salient. A discussion of safety (Code of Federal Regulations - DOT 4B), various types of ampoules and bubblers for use with liquids and or solids at increasingly higher temperatures will be discussed. NSI – is the largest premium quality manufacturer of Ampoules and Bubblers for use in ALD, CVD, Compound Semi and Epi in the world.

# Author Index

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