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Fall 2016 News

Scienta Omicron - Superior Technology

Strategic Partnership with CryoVac

Jointly Working on the New Scienta Omicron TESLA JT SPM

Sealing the strategic partnership:
Dr. Michael Krzyzowski, Managing Director CryoVac and Dr. Markus Maier, Business Unit Director SPM from Scienta Omicron.
Right: The new TESLA JT SPM

Scienta Omicron and CryoVac have signed a joint R&D and supply contract which gives Scienta Omicron access to CryoVac's proprietary Joule-Thompson cooling and dry magnet technology for commercial UHV Scanning Probe Microscopy.
CryoVac is one of the most renowned manufacturers for state-of-the-art UHV cryostat technology. Both partners have a long-standing relationship and have successfully completed joint projects in the past, supported by the companies' close location and a shared philosophy in German engineering. The shared ambition to push scientific boundaries with the highest quality products ensure a thriving collaboration.
R&D engineers of both companies have already formed a joint and fast moving team to soon offer you the new TESLA JT SPM, serving the increasing scientific demand for advanced STM and QPlus AFM imaging and spectroscopy at low temperatures and high magnetic fields.

Dr. Markus Maier, Business Unit Director SPM from Scienta Omicron, stated: 'We are very happy to announce this strategic partnership. A fascinating new product is on the way to market.'
Dr. Michael Krzyzowski, Managing Director CryoVac, pointed out: 'The cooperation with Scienta Omicron is ideal for our customers. We think they will get a very attractive product for their research.'

The new TESLA JT SPM perfectly fits into Scienta Omicron's comprehensive surface science technology portfolio and can also be integrated into tailored UHV solutions with MBE and electron spectroscopy, such as ARPES, UPS and XPS.
We are looking forward to discuss this new instrument with you!

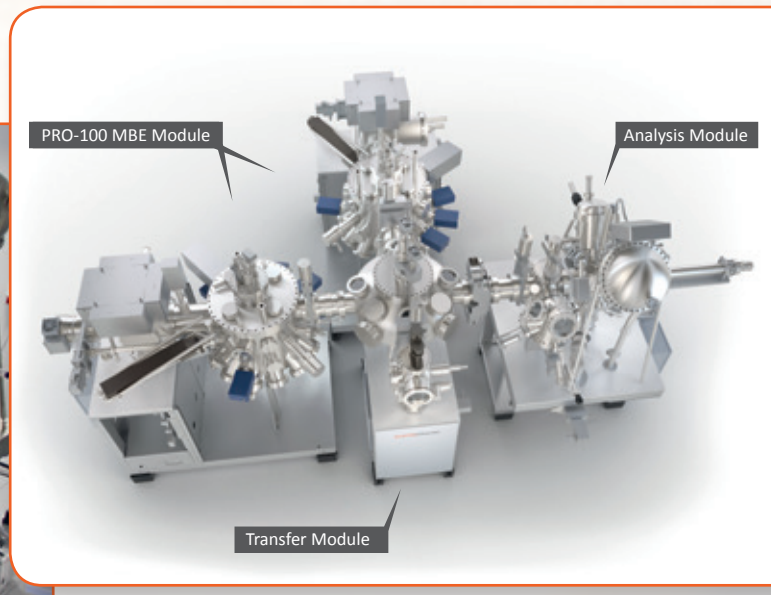
Prof. Hommel's System Installed in Poland at EIT+

In-situ Growth and Analysis of Functional Materials

The most innovative laboratory in Poland is now operating in full swing. Opened recently in Wroclaw, the focus of the lab is research on high-performance electronic materials. A state-of-the-art clean room laboratory assures the highest integrity necessary for sensitive materials.
The new Scienta Omicron UHV system is an integral part of the lab and consists of two PRO-100 MBE-modules connected by a central sample transfer to an analysis module.

In this design, novel materials for Spintronics and Optoelectronics can be prepared and analyzed on samples up to 4" in size completely in-situ.

The new Scienta Omicron system in Wroclaw - used for in-situ growth and analysis of functional materials by STM, AFM, RHEED, wafer curvature measurement and XPS.



Above: 3D graphic showing the different modules of Prof. Hommel's system in Wroclaw.

ESCA 2SR - a New XPS Instrument -

The Turnkey ESCA Solution

The ESCA 2SR is a new XPS instrument which provides outstanding XPS performance combined with a versatile design addressing the needs of today´s modern research lab. The ever changing demands of today's interdisciplinary research often conflict with the lack of flexibility in the design of conventional XPS instrumentation. The ESCA 2SR is designed to overcome the customary tradeoff to sacrifice high performance for ease of use, convenience or flexibility.

The ESCA 2SR provides unrivaled sensitivity for trace element analysis combined with the highest energy resolution for outstanding spectroscopic performance. Yet routine or large batch sample analysis is quickly and efficiently handled by the ESCA 2SR's automated sample stage for loading up to 30 samples at a time. To achieve this Scienta Omicron employs state-of-the-art 128-channel detector technology for massive parallel detection, advanced compression lens electron optics and an extraordinary high power monochromatic x-ray source supported in an intelligent instrument control system. But with over two decades' experience building customized XPS system we did not lose sight of the constant need for adaptation and individual experimentation.

A versatile range of standard tools

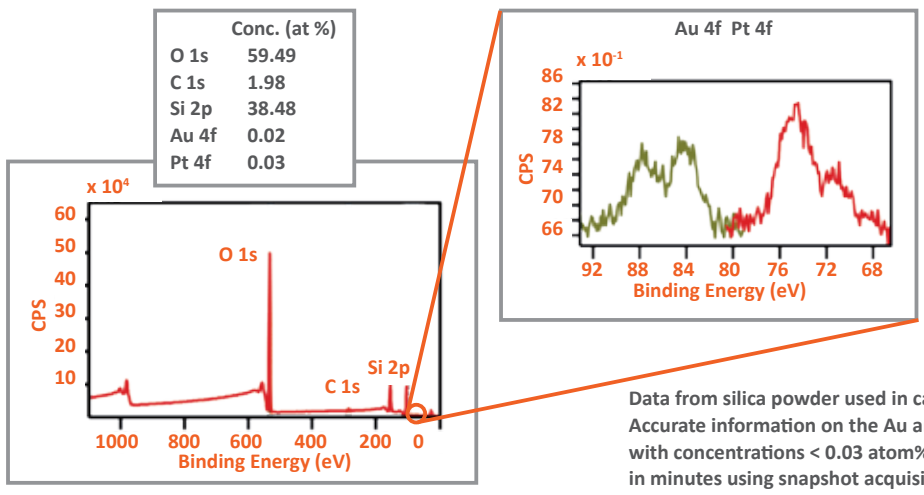
The ESCA 2SR can be configured from a selection of sources for charge neutralization and sputter depth profiling including a Gas Cluster Ion Beam, UPS, ISS and AES excitation sources.

ESCA 2SR´s large sample plate can be loaded with more than 30 samples at a time allowing for freedom to operate even at extreme take off angles and providing maximum flexibility on dimensions allowing samples up to 20 mm thick for automated analysis by XPS, depth profiling, AR-XPS, ISS/LEIS. Sample plates are transferred with a simple robust design allowing rapid sample exchange.

In a true departure from conventional XPS instrumentation the multi-sample plate can be simultaneously paired with a 'scientific stage' for individualized experimentation. The scientific sample stage provides for wide heating or cooling temperature variation and electrical signals for in-operando experimentation. Alternately these services can be used or integrated into individual customer created experimental platforms within the ESCA 2SR.

Extended preparation chambers are offered out of the large Scienta Omicron toolbox and more advanced system modules like a Lab10 MBE system can be easily interconnected to the ESCA 2SR. Ultimately the instrument can be integrated as a characterization facility within larger cluster systems.

ESCA 2 SR: Fast routine analysis with ultimate sensitivity



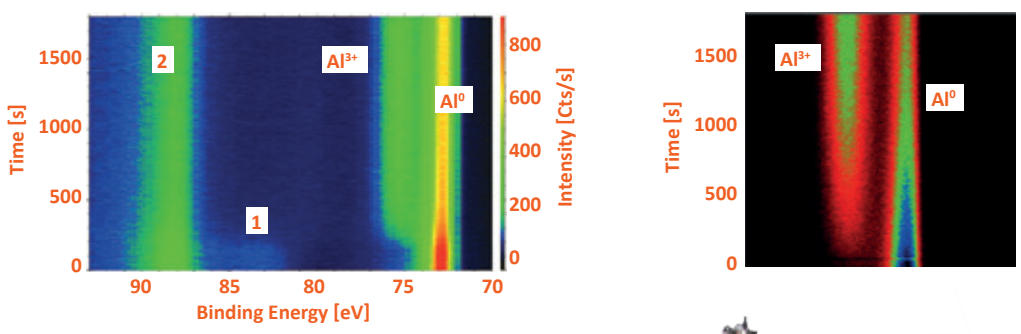
Data from silica powder used in catalysis. Accurate information on the Au and Pt traces with concentrations < 0.03 atom% are recorded in minutes using snapshot acquisition.

ESCA 2 SR: Oxidation of Aluminum

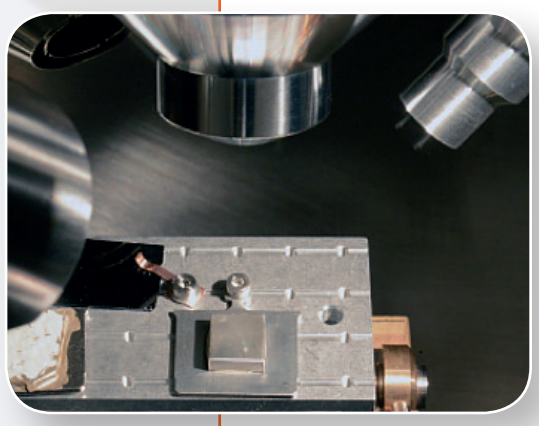
Snapshot time series

O_2 Dosing on Al 2p at room temperature (large snapshot window)
1 → 1st surface plasmon
2 → 1st bulk plasmon

O_2 Dosing on Al 2p at 500 °C



In a simple research experiment a clean Aluminium surface was exposed to $1x10^{-6}$ mbar of oxygen.
Continous in-situ XPS observation of the Al 2p line shows the reduction of the metallic Al at RT and 500°C.



Top: View on sample holder.
Right: ESCA 2 SR system

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MATRIX SPM Control System

New Release Available

We launched the MATRIX-SPM-Hardware-V3 which is delivered with the MATRIX-SPM-Software V3.3. Important features are:

- **Fully Digital**
- **Coarse motion can be controlled by the remote-box and by the MATRIX-SPM-software independently**
- **Full control of all SPM functions by remote access possible**
- **All coarse channels can be controlled by scripting (MATRIX - MATE)**
- **One MATRIX SPM Control System supports up to four independent STM´s**
- **Integrated support for Dual-Probe and Four-Probe systems**

MATRIX-SPM-Software V3.3 is available on our website. (www.Scienta Omicron.com/en/software-downloads)

For further questions regarding this or the installation please contact our Service team.

Left: The MATRIX-SPM-Hardware-V3: a modular, fully digital control system provides advanced and efficient SPM control. Now the coarse motion can be controlled by the remote-box and by the MATRIX-SPM-Software independently.

Above: Touch screen monitor of MISTRAL - a PLC-based partner software to MATRIX delivers visualization and complete control of all vacuum system components in the UHV system.

NanoESCA System for Bristol University

Final Test Before System Shipping

Prof. Neil Fox from Bristol University visited Scienta Omicron GmbH for final acceptance tests of his new state-of-the-art NanoESCA system.

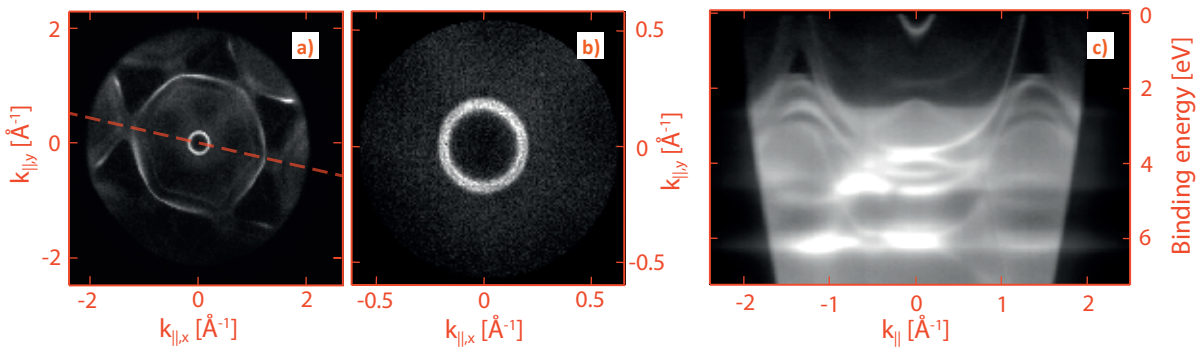
The University of Bristol is an internationally leading center of excellence in diamond materials research comprising an interdisciplinary team of 50 staff and post-graduate researchers. It is ranked amongst the top 40 world's best universities. The research activities are focused on transformative new energy applications utilizing diamond for terrestrial and space deployment. These environments require diamond components operating under extreme environments including high electrical power loading, very large temperature ranges and hard radiation conditions.

The NanoESCA facility will be installed in the University of Bristol's Centre for Nanoscience and Quantum Information in a dedicated ultra-quiet laboratory in October 2016. It will give users access to the UK's first nano-PEEM instrument and the ability to perform cutting edge research on materials using ultra-violet, X-ray and tuneable light sources. An energy resolution of 25 meV has been shown with this enhanced instrument. The NanoESCA is an Ultra High Vacuum (UHV) Photo Electron Emission Microscopy (PEEM) system with superior resolution for real-space and momentum-space imaging and spectroscopy. It will enable the electronic properties and chemical composition of thin layers of materials to be revealed and quantified by a non-destructive technique.

Scienta Omicron is proud to cooperate on this project with Bristol University to advance their important research.

NanoESCA Project PI, Dr. Neil Fox, said: 'The NanoESCA will enhance our ability to characterise new isotopic diamond materials, for renewable energy applications including concentrated thermal power generation, radiation powered sensors and beta-voltaic batteries.'
From left to right: Prof. Neil Fox, University of Bristol, Ad Ettema and Konrad Winkler from Scienta Omicron beside the NanoESCA system in Taunusstein.

k-space microscopy on Au(111):
Data recorded at T = 30 Kelvin, Photon energy: 21,18 eV (He I), Instrument energy resolution: 50 meV



a) Au (111) Fermi surface map (FoV 4.3 Å^{-1})

b) Zoomed view (FoV 1.1 Å^{-1}), circular surface state reveals Rashba splitting

c) Au (111) E-k cut along dashed line in (a), Scan E_{bin} = -0.08 … 7.22 eV, step 20 meV, Log intensity scale

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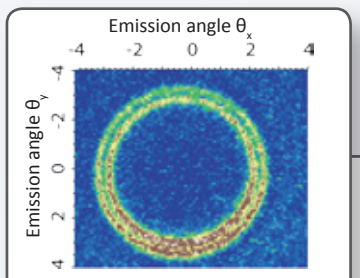
ARPES-Lab System:
The Complete Solution

The new ARPES-Lab System is a comprehensive offering for high performance, laboratory-based ARPES research. The system design takes advantage of Scienta Omicron's long history and extensive experience in the field of electron spectroscopy to integrate a combination of analyzer, excitation sources, chamber and sample handling.

The ARPES-Lab System is a surface analysis solution optimized for best performance with laboratory-based laser, UV and X-ray sources. Configurations ranging from entry-level to highest performance systems are available and can be upgraded and reconfigured to meet changing needs. As part of the Scienta Omicron product portfolio, the ARPES-Lab System is also prepared for multi-technique expansions, including the addition of SPM and MBE capabilities.

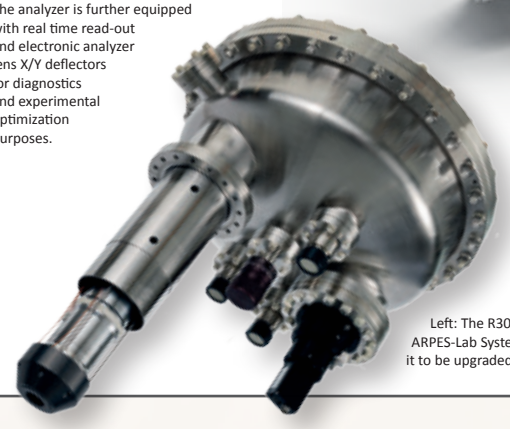
The ARPES-Lab System at a glance:

- **Intelligent integration and automation**
- **The DA30L features the revolutionary, patented deflection mode which provides for:**
  - **Simplified measurements without mechanical motion**
  - **Improved k_y accuracy with faster scans**
  - **Streamlined data analysis by elimination of matrix element effects by keeping the source/sample/analyzer geometry fixed during measurements**
  - **Excitation of the same sample point for a complete 2D $k_{||}$-scan**
- **Detectors available for spin-resolved measurements**
- **4-, 5-, or 6-axis cryo-cooled manipulator options**
- **Monochromated and small-spot laboratory UV sources providing highest flux for fast measurements**



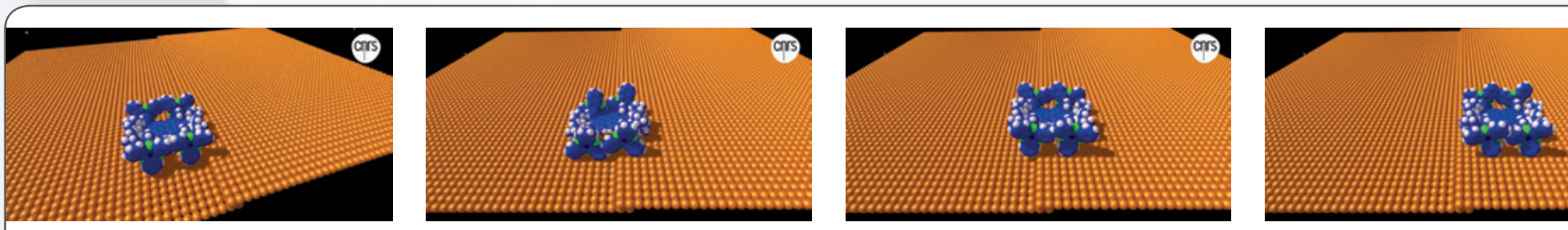
Fermi surface map of Au(111). The sample to source geometry was kept fixed for the entire measurement. The spectra were recorded at T = 77 K. (Measuring time < 1 min)
Data Courtesy: Dr. Ivana Vobornik, CNR-IOM, TASC Laboratory, AREA Science Park, Trieste, Italy.

Right: An ARPES-Lab System equipped with a DA30L analyzer: optimized for quick, high-resolution PES and ARPES measurements using a 200 mm mean radius hemispherical electron analyzer designed for high transmission. Electron detection is accomplished with modern, low noise, digital 2D CCD-MCP detector system with a noise level of < 0.01 cps/channel. The analyzer is further equipped with real time read-out and electronic analyzer lens X/Y deflectors for diagnostics and experimental optimization purposes.



Left: The R3000 analyzer as a lower cost option for the ARPES-Lab System. The system's flexible design allows for it to be upgraded with a DA30L at a later date if desired.

NanoRace in Toulouse
Nano-Cars to Race Across Frozen Gold Track in the LT NANOPROBE



3D simulation of a nano-car during training. Source: news.cnrs.fr/videos/the-smallest-car-race-in-the-world

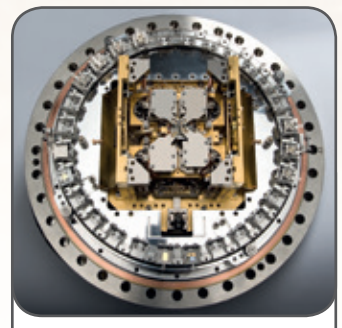
The world's smallest 'cars' are gearing up for the world's first nano-race. In this case each 'car' is a different molecule developed by teams from Germany, France, Switzerland, the USA and a collaboration between researchers from Austria and the USA. They will race in 'Runway' – a Scienta Omicron ultra-high vacuum LT NANOPROBE system installed at the Pico-Lab in Toulouse. The race has been organized by the Center for Materials Elaboration and Structural Studies (CEMES) of the French National Center for Scientific Research (CNRS).

Each team will be provided a 'raceway' prepared on a small portion of the (111) face of the same gold crystal surface.

The surface will be kept at T = 5 K in UHV during the lead up to and for the duration of the race. The race itself will run no longer than 2 days and 1 night. This includes the effort needed for raceway construction - the time required to clean and construct the same identical course, atom-by-atom, using surface gold ad-atoms for each competitor.

The construction and the imaging of the raceways, as well as the propulsion of the nano-cars, are all done with the four low temperature scanning tunneling microscopes of the LT NANOPROBE. Each of the tips are operated independently and in parallel – to be certified by independent 'Track Commissioners' before the start of the race. Each nano-car has to move across a herringbone circuit consisting of three straight lines and two 45° turns (one left, one right) from the start line to the finish line. Each line is defined by two gold ad-atoms or two non-moving molecule-cars. The goal is for four different nano-cars to compete simultaneously and in parallel on the same gold surface using the LT NANOPROBE.

The race will be run in spring 2017.
The Grand Prize for the winning team is dinner at the best restaurant in Toulouse.
Best of luck to all of the race's participants!
Further information can be found at:
www.cemes.fr/Molecule-car-Race
www.nanocar-race.cnrs.fr



'Runway' for the Nano-Race in Toulouse: the Scienta Omicron LT NANOPROBE.
Shown here: the LT NANOPROBE stage.