scientaomicron

HiPP-3 - Electron Spectrometer

Outstanding Imaging XPS at Ambient Conditions

The HiPP-3 analyser features a newly developed technology for outstanding imaging XPS at ambient conditions with a spatial resolution of better than 10 µm. In addition, the unique Swift Acceleration Mode enables unparalleled transmission, with countrates improved by up to a factor of 10.

Where its predecessor, the Scienta Omicron HiPP-2, was developed for HAXPES, enabling kinetic energies up to 10 keV, the Scienta Omicron HiPP-3 analyser has been optimised for XPS energies (up to 1500 eV). In this range, the transmission has been dramatically increased with the development of a new lens mode, described below.

Conceptually, Scienta Omicron HiPP-3 is similar to earlier APPES models in that it consists of a traditional Scienta Omicron R4000 analyser amended with a pre-lens that contains both differential pumping and electrostatic lenses. However, the pre-lens has been completely redesigned to offer the best transmission and spatial mode measurements at XPS energies. As before, there is an exchangeable front cone separating the pre-lens from the sample, enabling the optimum balance between pressure and transmission.

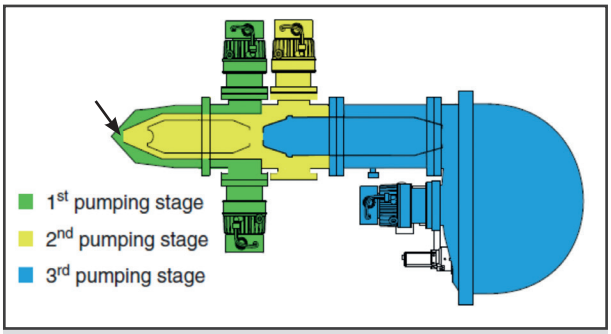


Figure 1: Differential pumping stages in Scienta Omicron HiPP-3. The arrow indicates where a high voltage is applied to accelerate electrons into analyser.

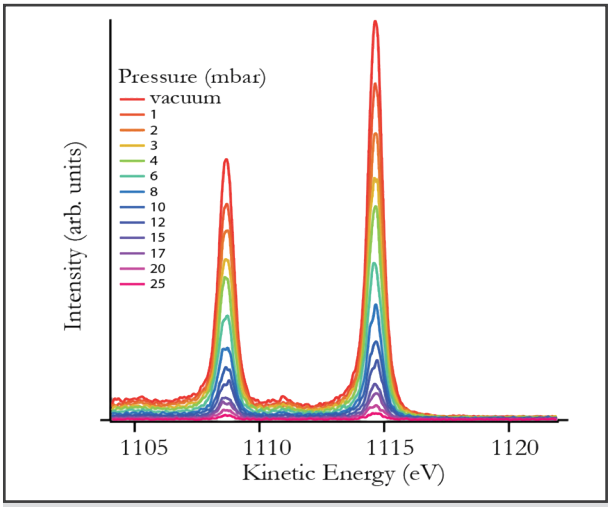


Figure 2: Ag 3d spectra recorded in different pressure of N_2. The measurement time for each spectrum was 60 seconds.

Excellent transmission at ambient conditions

The HiPP-3 analyser features a new and improved version of the Swift Acceleration Mode. With this mode, electrons are accelerated towards the analyser by a large voltage applied to the second aperture of the differential pumping stage, see figure 1. Due to this acceleration, the inelastic scattering of the photoelectron in the surrounding gas decrease dramatically. Compared to traditional transmission modes, count rates are increased by up to one order of magnitude.

Technical Highlights:

- Imaging XPS < 10 µm resolution
- Swift Acceleration Mode for unprecedented transmission
- Refocusing pre-lens with efficient differential pumping
- Angular resolved range: 18°
- Interchangeable / customized front cones
- A breakthrough in Ambient Pressure PES
- Imaging XPS
- Outstanding Transmission

Transmission tests have been performed with the Scienta Omicron MX650 HP Al Kα X-ray source. The resulting pressure dependence can be seen in figure 2. The figure shows a pressure series of Ag 3d from vacuum up to 25 mbar of N_2.
Due to the Swift Acceleration Mode, the signal decrease due to inelastic scattering is much less severe than for traditional analysers. An example of a spectrum recorded at 25 mbar is seen in figure 3.

This spectrum demonstrates that high resolution spectra with good statistics can be rapidly recorded even with a lab source.

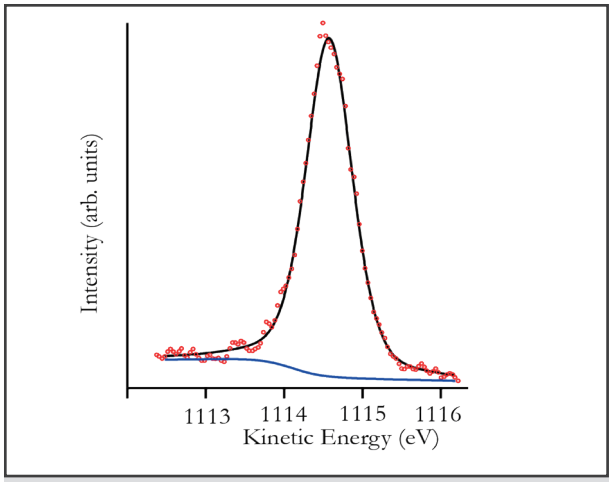


Figure 3: Ag 3d spectra recorded in 25 mbar pressure of N_2. The measurement time was 17 minutes. Analyser settings corresponds to a peak width of 0.7 eV.

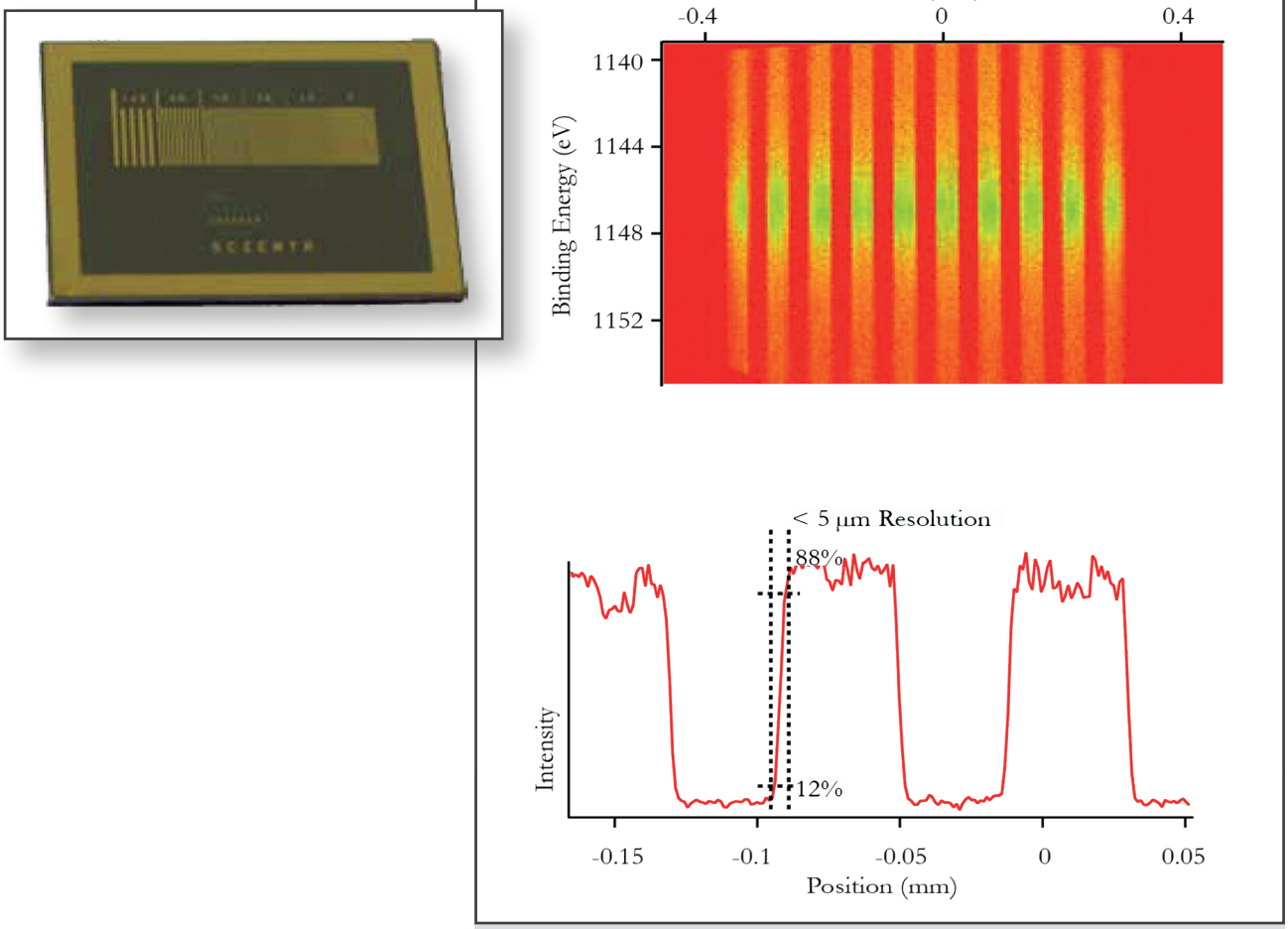
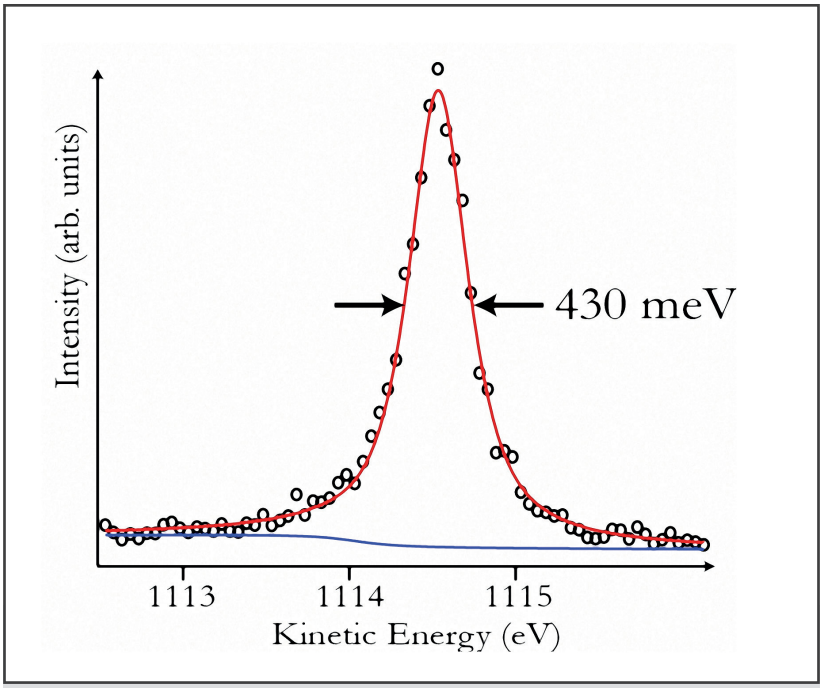


Figure 4: Demonstration of spatial resolution.
Top (Insert): A special test sample consisting of narrow lines of Au on Si, with the sample region magnifiifed to the right.
Center: Detector image showing parallel detection of kinetic energy and emission position.
Bottom: Integrated spectrum showing a spatial resolution of better than 5 µm.
This resolution is acheived by a new patent pending imaging technology.

Spatial Mode measurements
The HiPP-3 analyser features a revolutionary imaging mode. This mode enables parallel imaging in one direction with a guarantee resolution of better than 10 µm in a field of view of up to 0.8 mm. This mode is avaliable in both UHV and at ambient conditions.

Figure 4 show test data verifying the performance of the imaging mode. Test measurements have been performed at a dedicated development system at Scienta Omicron using the Scienta Omicron MX650 HP, which is an Al Kα monochromatic X-ray source adapted for high pressure, and a special test sample with narrow gold lines on silicon. In this study, gold lines with the width of 40 µm have been used. Measurements have been performed for the Au 4d core level.

The top of figure 4 shows a picture of the test sample. The center figure show the parallel detector image, with kinetic energy along one axis and position along the other. The bottom figure show a cut out of the detector image. From the slope of the curve, a spatial resolution of better than 5 µm has been demonstrated.



High Resolution XPS
With the excellent resolution and transmission of the Scienta Omicron HiPP-3 analyser in combination with the powerful monochromatic x-ray source Scienta Omicron MX650 HP, high resolution XPS can be recorded faster than ever, at both UHV and ambient conditions. The figure to the right shows a Ag 3d5/2 spectrum with a FWHM of less than 430 meV. Black circles are data points, blue is a background line and red line is the fitted spectrum.

Technical Data

Technology Overview

Property	Target Specification
Energy resolving power	> 1750 (0.2 mm slit)
Max., theoretical energy resolving power	4000 (0.1 mm slit)
Pressure	< 5×10^{-10} mbar Up to 30 mbar, verified for N_2
Baking temperature	120 °C
Analyzer radius	200 mm
Mounting flange	NW 200 CF, fixed
Working distance	0.3 - 9 mm, depending on aperture
Slits	9
Detector type	MCP/CCD camera
Detector interface	Ø 40 mm MCP
Energy channels	> 1000 simultaneous
Angular channels	> 750 simultaneous
Lens modes	Transmission, Swift Acceleration, Angular, Spatial
Acquisition modes	Swept, fixed
Detector modes	Pulsed, ADC
Intensity deflectors	Yes (x, y)
ISS	Option
Analyser pumping recommendations	First stage: 2x300 l/s Second stage: 1x300 l/s Third stage: 1x300 l/s

High Voltage Electronics

Property	Specification
Temperature stability	< 2 ppm/°C (R-version) (typical 0.5 ppm/°C)
Noise (AV at analyzer)	< 1 ppm + < 500 µV (typical 0.5 ppm + < 200 µV)
Drift	< 20 ppm/year (typical 10 ppm/year)
Electric isolation	6 kV
Min. step size HV100	1.6 mV
Min. step size DAC	200 µV
DAC	Bits 16
Modular	Yes
Communication	USB

	HiPP-3 XPS	HiPP-3 UPS upgrade*	HiPP-3 6 keV upgrade*
Property:	Target Specification	Target Specification	Target Specification
Energy resolution:	15 meV at 500 eV	1.8 meV at 10 eV	40 meV at 6 keV
Spatial resolution:	10 µm meV up to 1200 eV 20 µm meV up to 1500 eV	10 µm meV	
Angular resolved range:	± 9°	± 9°	± 9°
Kinetic energy range			
Transmission mode:	5 - 1500 eV	2 - 100 eV	1500 - 6 keV
Angular mode:	5 - 1500 eV	2 - 100 eV	1500 - 1950 eV
Spatial mode:	5 - 1500 eV	2 - 100 eV	
Pass Energy:	5 - 200 eV	2 - 10 eV	

*Specifications in addition to HiPP-3 XPS

How to contact us for further info:

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