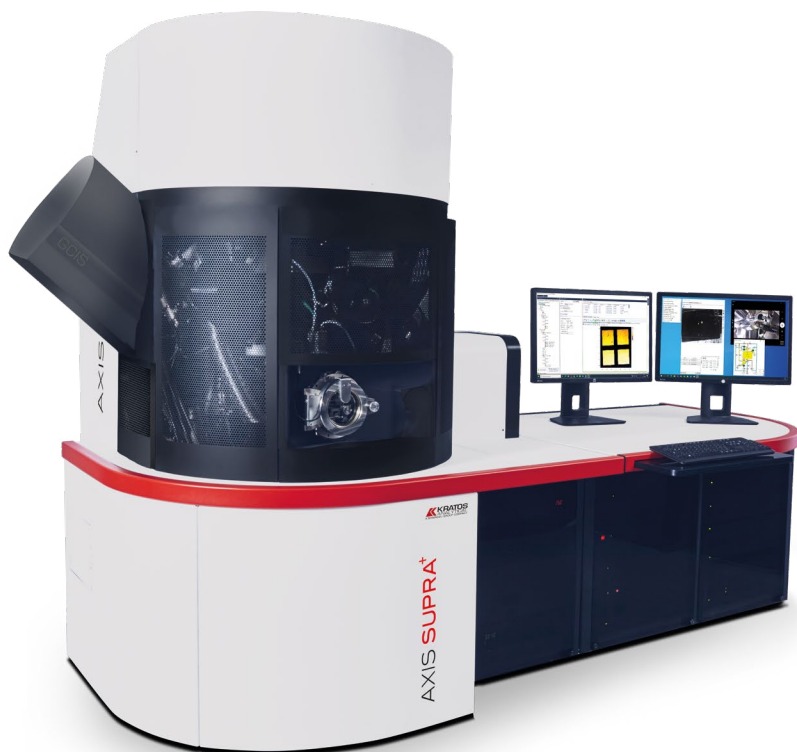


Automated, surface analysis X-ray photoelectron spectrometer

# AXIS SUPRA<sup>+</sup>



# Introducing the AXIS Supra<sup>+</sup>

The **AXIS Supra<sup>+</sup>** sets the standards for X-ray photoelectron spectrometer performance. It is a fully automated instrument with unattended sample holder exchange and computer control of instrument parameters, facilitating easy remote operation.

The **AXIS Supra<sup>+</sup>** combines excellent spectroscopic performance with market leading XPS imaging, providing an instrument that is capable of performing at the cutting-edge of surface analysis. The **AXIS Supra<sup>+</sup>** can be configured with several complementary surface analytical techniques, sample handling options and surface modification accessories.

Kratos' ESCAPE data system supports completely integrated acquisition and data processing, allowing the **AXIS Supra<sup>+</sup>** to perform to its maximum capability. Intelligent data dependent acquisition (DDA) drives automated spectral acquisition.

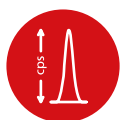
[Learn more](#)

## Technique

X-ray Photoelectron Spectroscopy (XPS), also known as Electron Spectroscopy for Chemical Analysis (ESCA) is a widely used analytical technique for the surface characterisation of materials. Typically using monochromated Al K $\alpha$  excitation, XPS provides quantitative chemical information from the uppermost 10 nm of a material. The technique is used in both industrial and academic research, characterising surfaces with applications as diverse as bio-compatible polymer materials to solid electrolytes for energy storage.

**Automation  
without compromise**

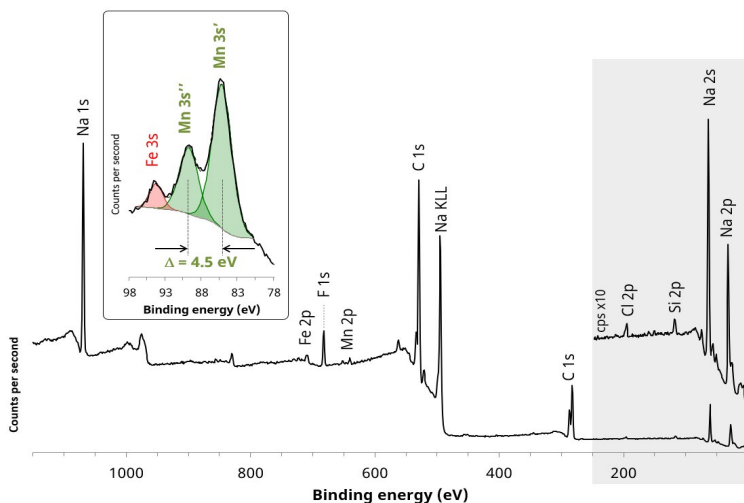
# Capabilities of the **AXIS Supra+**



## Spectroscopy performance

The **AXIS Supra+** is optimised for chemical state X-ray photoelectron spectroscopy. Efficient collection of photoelectrons combined with high transmission electron optics ensures unrivalled sensitivity and resolution at large analysis areas.

- Easy detection of light elements.
- Excellent signal-to-noise, even at low concentrations.
- Fast data acquisition.
- Scanned and 128-channel snapshot spectral acquisition.



Survey spectrum from Na-ion battery cathode material. Expanded region shows trace elements with (inset) high resolution Mn 3s region showing Mn +4 oxidation.

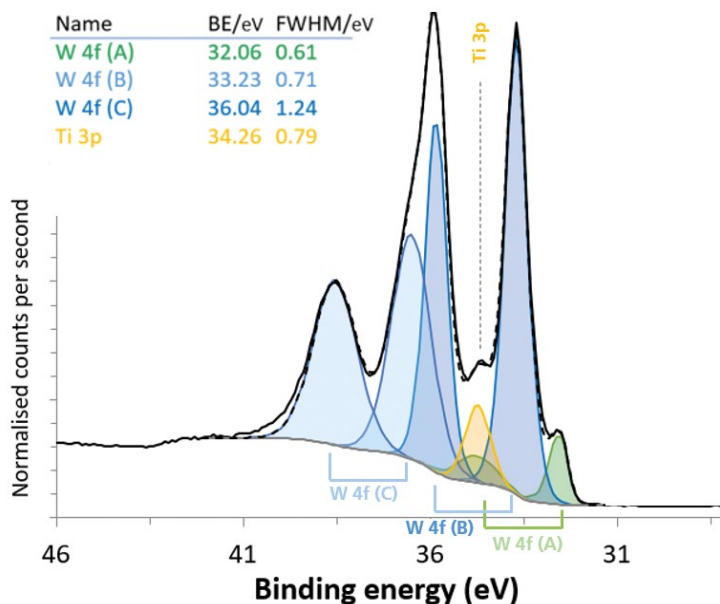


## Highest energy resolution

The **AXIS Supra+** has a large 500 mm Rowland circle monochromated Al K $\alpha$  X-ray source and optimised electron optics ensuring excellent chemical resolution.

- Unambiguous identification of chemical shifts.
- Guaranteed energy resolution on insulating and conducting samples.

**AXIS Supra+** Users cite the instruments large area XPS sensitivity and energy resolution as its greatest strength. All surface analysis starts with a survey spectrum – the **AXIS Supra+** provides the best performance of any spectrometer available in this mode.



High resolution, narrow region scan of W 4f and Ti 3p components from alloy thin film.



## Selected area spectroscopy

Excellent small spot sensitivity is guaranteed by optimising X-ray illumination of the sample with the analysis area selected. Analysis positions are simply defined either from the real-time optical microscope or an XPS image.

- Pre-defined, calibrated small spot analysis areas.
- Optimised X-ray illumination for improved selected area performance.
- Virtual probe created by automated aperture and iris in the lens column.
- Selected area spectra acquired using either the monochromatic or achromatic X-ray sources.

For even greater lateral resolution coincident Auger electron spectroscopy (AES) can be added to the **AXIS Supra+**. The 10 keV field emission electron source also provides 100 nm resolution secondary electron microscopy (SEM) and scanned Auger mapping. (SAM)

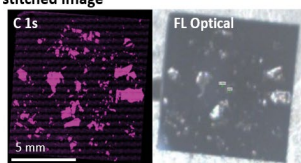


## XPS imaging

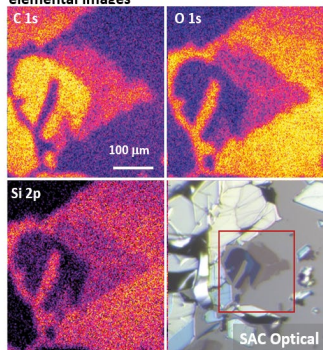
The lateral distribution of elements or chemistry at the surface is measured by XPS imaging. The **AXIS Supra<sup>+</sup>** has a unique spherical mirror analyser for fast, high spatial resolution parallel imaging. Parallel imaging may also be combined with stage movements to acquire a 'stitched' image, capable of generating images over several millimetres with spatial resolution of several microns.

- Ultimate spatial resolution of 1  $\mu\text{m}$  at the highest magnification.
- Elemental and chemical state imaging capabilities.
- Quantitative imaging.
- Spectromicroscopy – acquisition of datasets providing a spectrum at each pixel.

stitched image

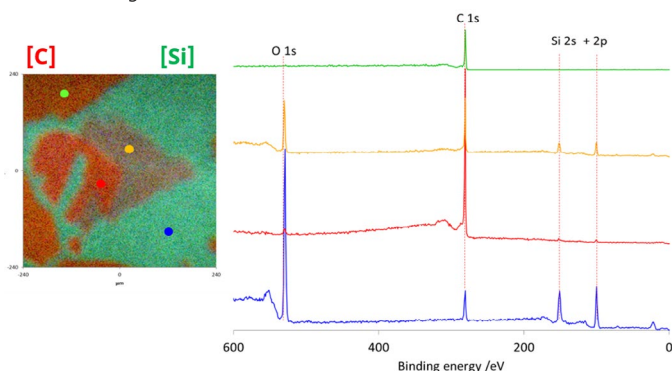


elemental images

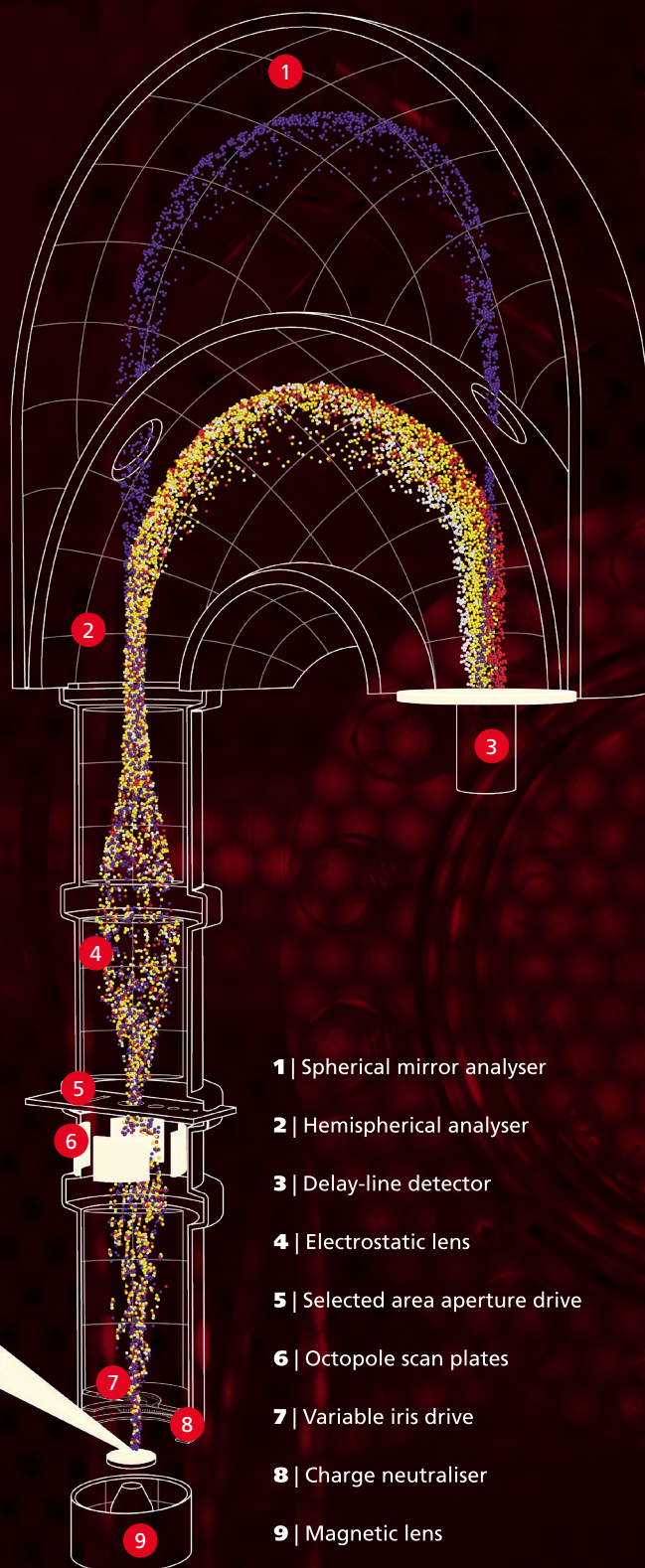


[Learn more](#)

Carbon stitched image with >10 mm field of view allowed an area of interest to be identified and subsequent acquisition of high spatial resolution elemental images.



Overlay of carbon (red) and silicon (green) images, used to define 27  $\mu\text{m}$  diameter selected area survey spectra



# From surface to bulk

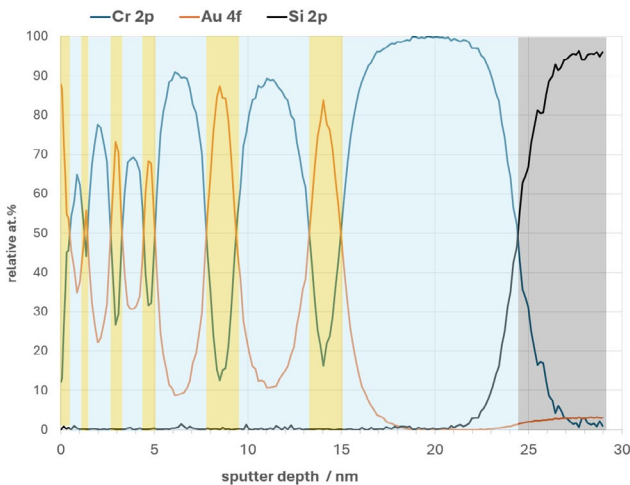
XPS typically probes the uppermost 10 nm of the material. The **AXIS Supra+** can collect angular dependent data, with a software algorithm calculating a non-destructive concentration depth profile of elemental or chemical distribution through the sampling depth.

The sampling depth can be increased up to 20 nm by using the Ag L $\alpha$  hard X-ray (HAXPES) monochromatic source.

Thin films, multilayer materials and bulk material properties can be characterised by combining XPS with destructive, sputter depth profiling. The **AXIS Supra+** can be configured with a Minibeam 4, conventional monatomic Ar<sup>+</sup> source or Minibeam 6, multi-mode, Ar<sub>n</sub><sup>+</sup> gas cluster ion source. Both ion sources are fully controlled through ESCAPE software, with automated gas handling, including pump and purge for changing to He gas for ion scattering spectroscopy (ISS).

## Minibeam 4

- High flux Ar<sup>+</sup> monatomic ion source.
- Suited to inorganic and metallic sputter depth profiling.
- 0.5 – 4 keV ion energy, incorporating floating ion column.
- He<sup>+</sup> capability for ISS.



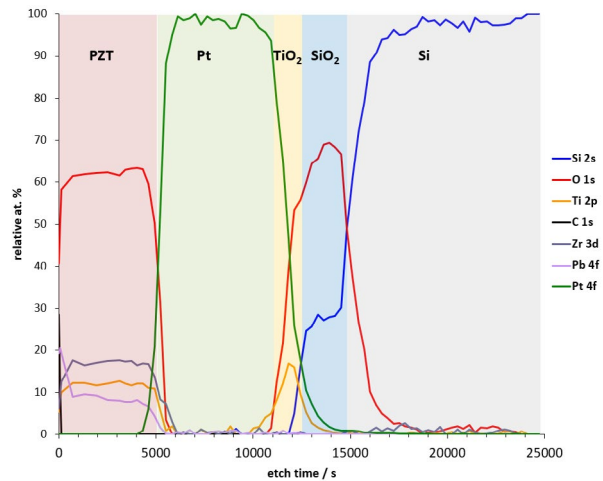
Au/Cr ultra-thin multilayers with calibrated thicknesses\* depth profiled using Minibeam 4 in monatomic mode.

\* sample provided by C. Guillemard, CINAM, France.

## Minibeam 6

[Learn more](#)

- Multi-mode Ar<sub>n</sub><sup>+</sup> cluster ion source.
- Suited to organic sputter depth profiling.
- Ar<sup>+</sup> monatomic mode 0.5 – 5 keV ion energy.
- Ar<sub>n</sub><sup>+</sup> Cluster mode n=500 to 3000, ion energy up to 20 keV.
- He<sup>+</sup> capability for ISS



Sputter depth profile through a PZT/Pt/TiO<sub>2</sub>/SiO<sub>2</sub>/Si multilayer sample using 20 keV Ar<sub>500</sub><sup>+</sup> ions.

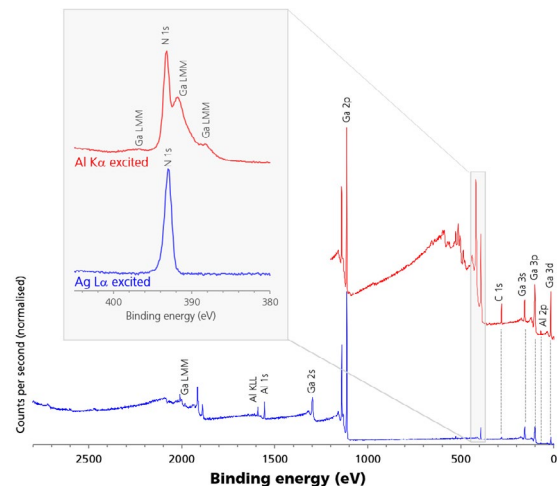
## More than XPS : complementary techniques

[Learn more](#)

At Kratos Analytical we understand that the instrument must solve numerous materials surface challenges. Combining XPS with optional excitation sources is important to provide a complete materials characterisation solution. Importantly, addition of these techniques does not compromise the market leading XPS performance.

Additional (optional) techniques coincident with XPS analysis position include:

- Helium discharge lamp for ultraviolet photoemission spectroscopy (UPS).
- High energy Ag L $\alpha$  monochromated X-ray source (HAXPES).
- Field-emission electron source
  - Auger electron spectroscopy (AES), scanned
  - Auger mapping (SAM) and secondary electron microscopy (SEM).
- Inverse photoemission spectroscopy (IPES).
- Ion scattering spectroscopy (ISS).

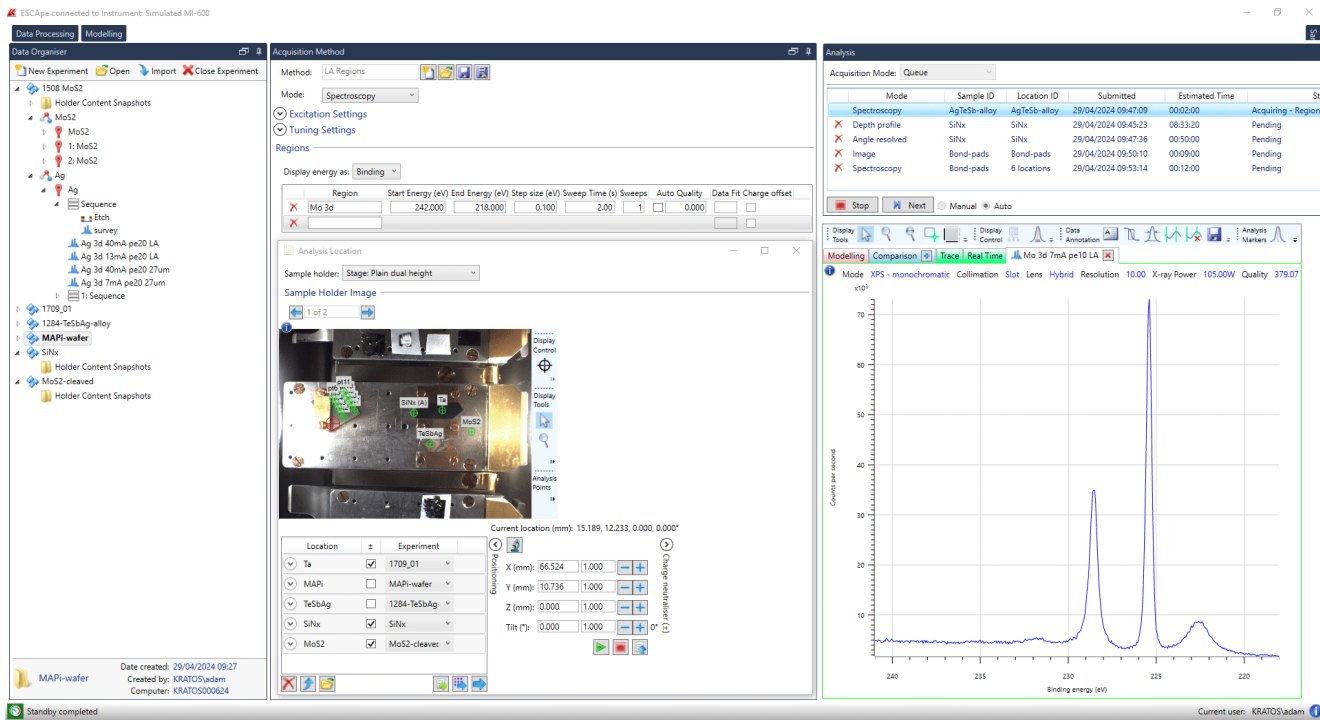


Al<sub>x</sub>Ga<sub>1-x</sub>N sample analysed with conventional Al XPS (red) and Ag HAXPES (blue). Using the HAXPES source shifts the Ga LMM Auger peaks from the N 1s region, as shown in the high-resolution scans (inset).

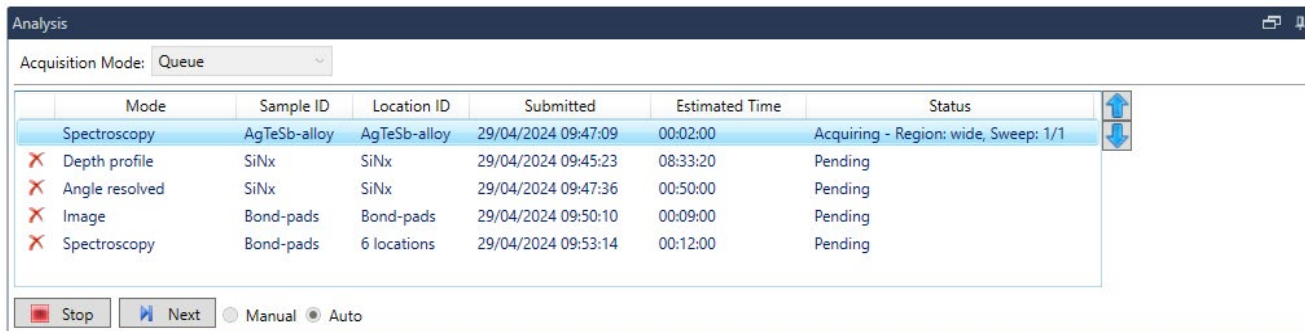
# Ease of use

[Learn more](#)

The ESCAPE data system seamlessly integrates data acquisition with hardware automation and provides intuitive data reduction and reporting. Flexible acquisition methods allow the definition of simple, routine high throughput analysis or complex, unattended, multi-technique experiments.



ESCAPE User interface is designed for ease of data acquisition with simple workflows and software guided acquisition and reporting.

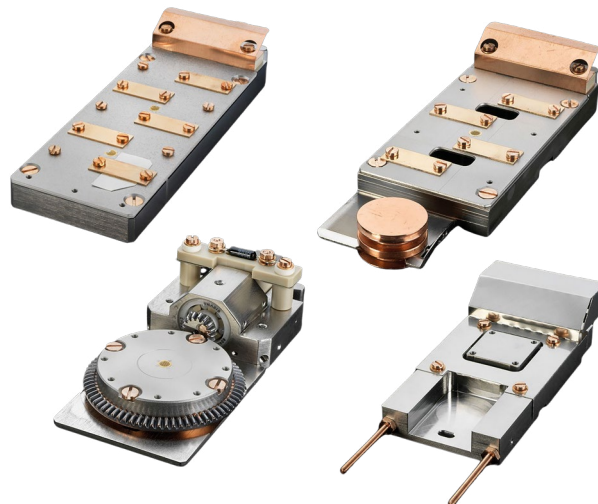


Acquisition methods can be queued, leaving the AXIS Supra<sup>+</sup> to acquire data unattended.

Up to 3 sample holders can be introduced into the spectrometer at a time. Automated sample exchange allows continuous sample analysis without User intervention. Optional sample holders are available to accommodate numerous advanced experimental requirements including heating and cooling, in-situ sample bias/current, cryo-XPS sample cooling and air sensitive sample handling variants of these holders.

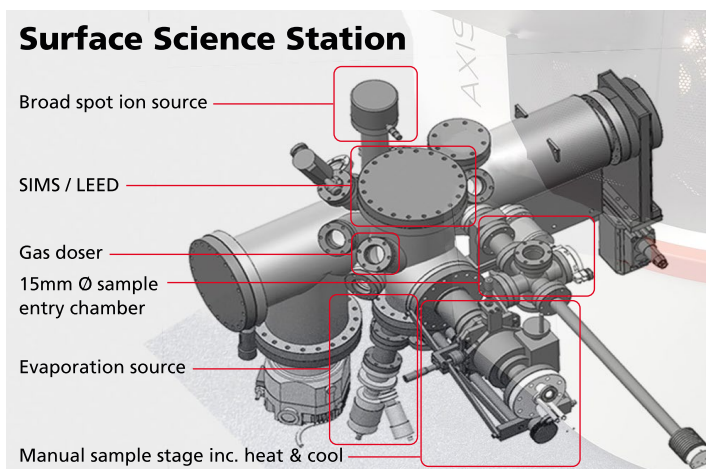
Designed for ease of use by novice or expert:

- Fully automated workflow, from sample entry, data system guided acquisition to quantification and reporting.
- Automated, unattended sample holder exchange.
- High throughput, rapid sample analysis.
- Experimental methods, ideal for a multi-User environment.
- Easy data reporting through MS Office applications.



# Sample preparation and surface modification

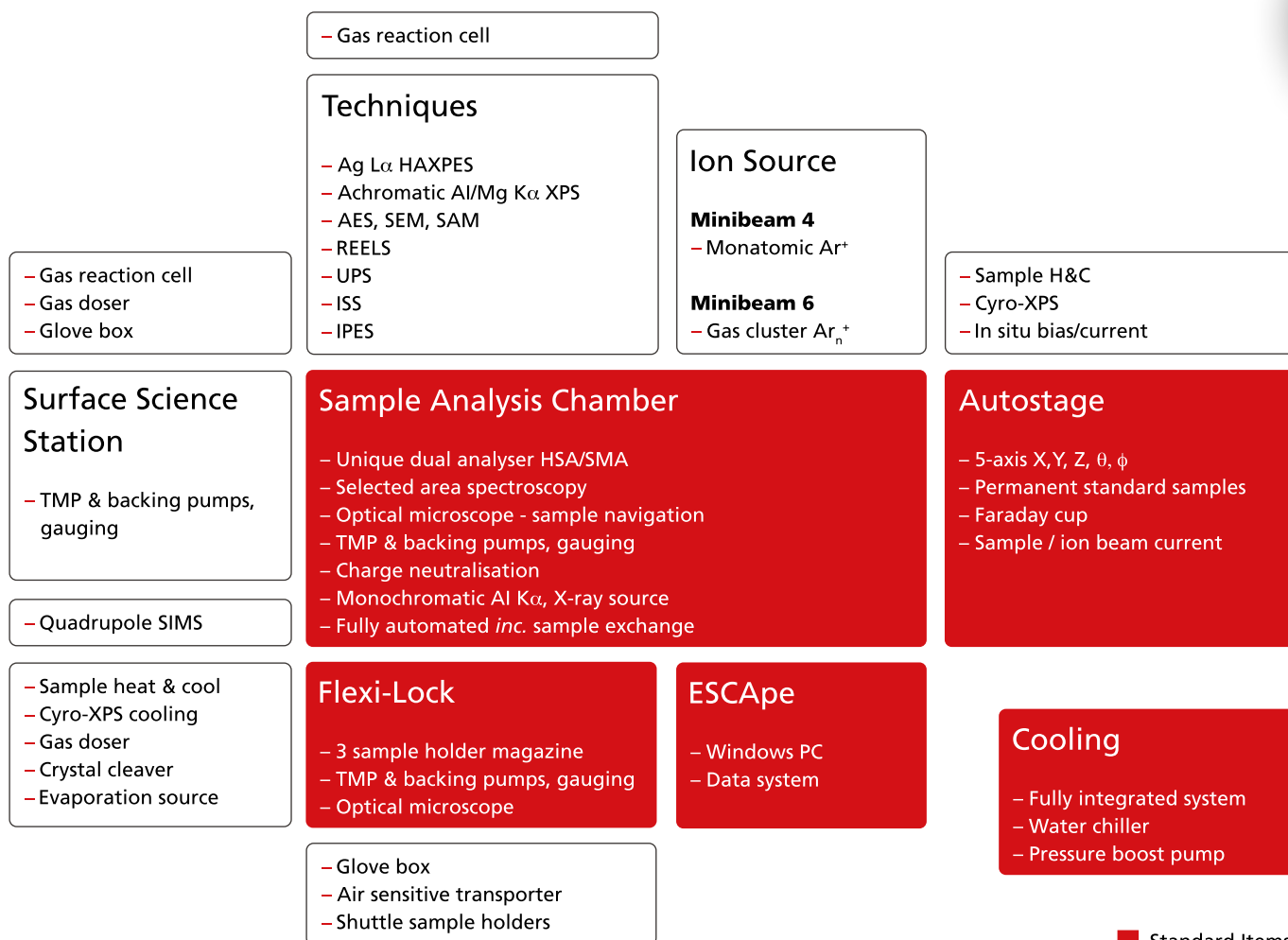
These options include sample heat and cool, air sensitive sample transporter, broad spot ion source, crystal cleaver and glove box. A third chamber can be configured to provide a dedicated UHV environment for surface science studies. Typical configuration equips this chamber with a manual stage with heat/cool capability and optional characterisation techniques including low energy electron diffraction (LEED) and quadrupole secondary ion mass spectrometry (SIMS). Provision for high temperature and pressure studies is provided by a gas reaction cell.



## AXIS Supra<sup>+</sup> : made to measure

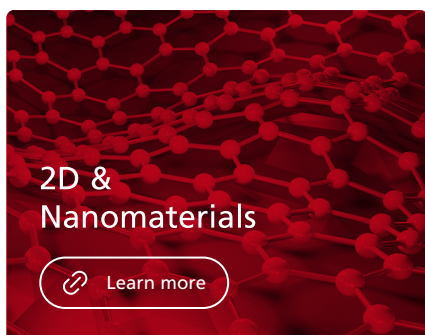
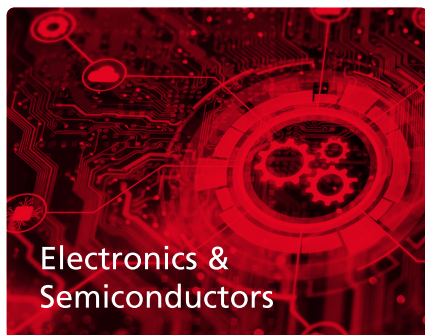
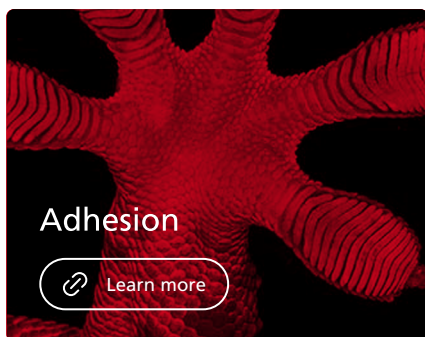
[Watch video](#)

We understand that the ability to configure the spectrometer to your analysis requirements is essential. We have over 50 years experience of instrument development and offer greater integration of complementary analysis techniques and sample modification accessories than any other instrument manufacturer.



■ Standard Items  
□ Optional Items

# Application Areas



Kratos Analytical Limited is a wholly owned subsidiary of Shimadzu Corporation of Kyoto, Japan. We have over 50 years' experience of manufacturing and selling X-ray photoelectron spectrometers and associated surface analysis instruments. We are proud that all Kratos products are designed, assembled and supported from our headquarters in Manchester, UK.