UPDATE Titanium line

µFOCUS 450

THE MOST VERSATILE X-RAY SOURCE
FOR CUTTING EDGE (NAP)-XPS/HAXPES

KEY FEATURES

- Multiple photon energies, Al Kα / Ag Lα / Ti Kα / Cr Kα
- One source with four optimized X-ray lines
- Variable spot size from <100 µm to >500 µm
- Ultimate photon flux densities
- Full software control

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µFOCUS 450

FOUR INDIVIDUAL MONOCHROMATED
X-RAY LINES IN ONE SOURCE

Multi Excitation Energies

The µFOCUS 450 is a unique small-spot Rowland-geometry X-ray monochromator dedicated to surface analysis and non-destructive depth-profiling by offering variable excitation energies. It provides a fully software-controlled, in-situ selection of up to four monochromated X-ray excitation lines – Al Kα (1487 eV), Ag Lα (2984 eV), Ti Kα (4511 eV) and Cr Kα (5414 eV) – opening the way to advanced XPS/HAXPES experiments under ultra-high vacuum (UHV) as well as in near-ambient pressure (NAP) conditions in a laboratory.

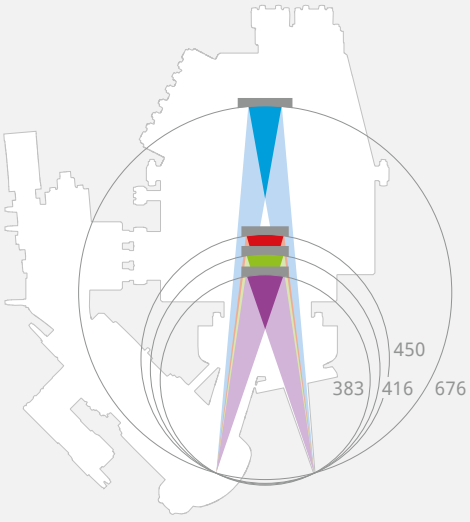
Source Design

In contrast to traditional source concepts that often derive multiple X-ray energies from a shared crystal, the µFOCUS 450 incorporates dedicated monochromator assemblies for each X-ray line within a single source housing. Each configuration combines an optimized anode and crystal, maximizing photon flux density and spectral performance across the full energy range. The design allows for an upgrade of each X-ray line at any time and also provides specialized NAP extension for seamless operation at elevated pressures up to 50 mbar.

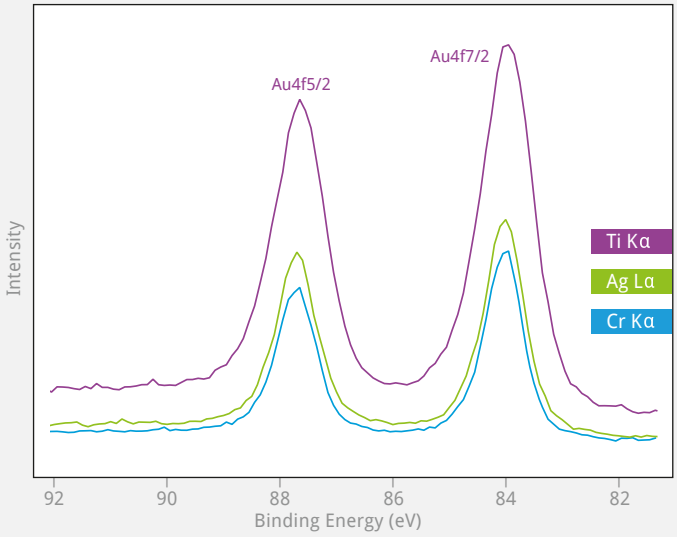
The titanium Kα line, newly integrated into the source design, is unique in the market and closes the energy gap between silver and chromium. It offers substantially higher usable photon flux than Ag and Cr while maintaining high excitation energy, leading to improved count rates and better signal-to-noise in less time for quantitative layer thickness and interface characterization.

Software Control and Optimization

Each X-ray line is individually optimized for peak performance, with precise control of the monochromator position, anode alignment, and the insertion or retraction of individual monochromators. Traditionally, switching between X-ray lines would require careful manual realignment and setup; here, all adjustments are handled through intuitive software control. Users can switch between X-ray lines instantly during a single exper-



Monochromator layout with Rowland Circles; in mm



HAXPES analysis of Gold using Ti Kα, Ag Lα, and Cr Kα lines

iment, enabling rapid, uninterrupted changes that provide real-time depth information. Experiments can also be run unattended for extended periods – overnight, over weekends, or during the day – with minimal intervention required all while switching between sources

Laboratory (NAP)-XPS/HAXPES

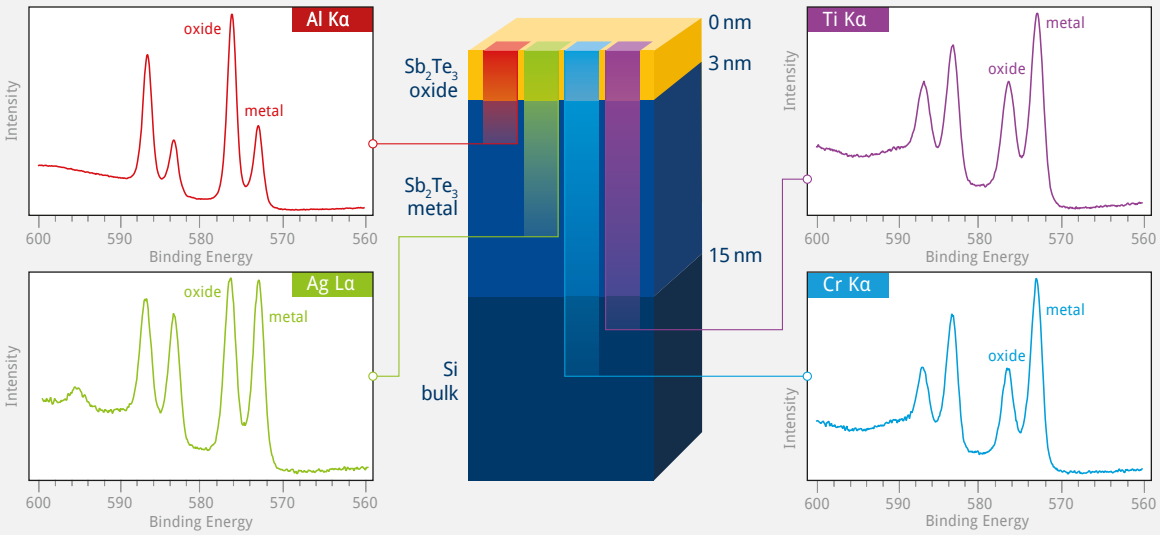
Advanced photoelectron spectroscopy requires a stable, tunable and high-intensity X-ray excitation, the µFOCUS 450 is engineered to meet this demand. The µFOCUS 450 provides a multi-line platform spanning both low- and high-energy X-rays for XPS and HAXPES in UHV and NAP environments. This capability enables experiments that would otherwise require access to large-scale synchrotron facilities, expanding the scope of laboratory-based surface analysis. High-throughput, high-quality measurements can now be performed in-house, helping bridge the gap between conventional laboratory instrumentation and specialized synchrotron techniques.

Non-Destructive Depth Profiling

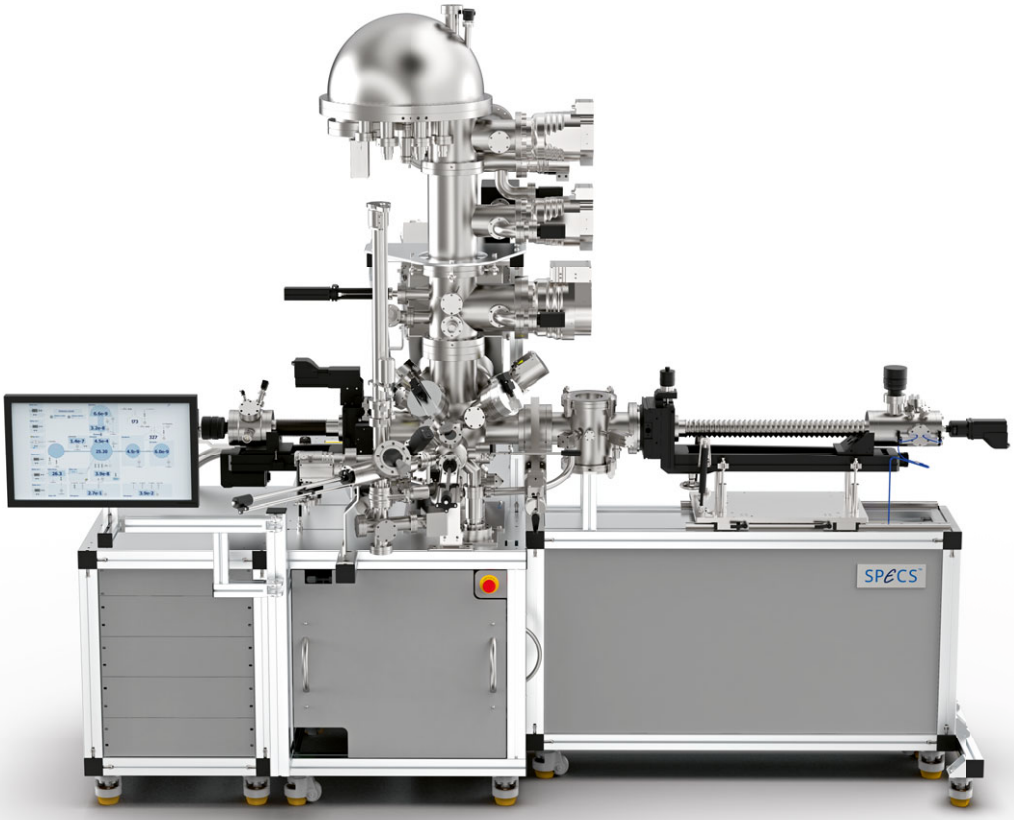
Non-destructive multilayer thickness analysis requires variable-energy excitation to probe both surface and bulk regions of a sample. However, deeper probing typically comes with reduced ionization cross-sections and lower count rates. The µFOCUS 450 addresses this gap by combining small-spot, focused excitation with a broad tunable energy range in a single instrument, enabling high-quality data acquisition from surface-sensitive to bulk-sensitive regimes for accurate multilayer thickness modeling. In combination with a wide acceptance angle analyzer like the AEOLOS 150, Variable Energy PARXPS (VE-PARXPS) measurements generate a non-destructive, complete and precise understanding of complex-layered materials.

NAP Measurements

The combination of a near ambient pressure environment with tunable XPS/HAXPES source excitation has become a powerful combination that allows to tackle a wide range of complex analyt-



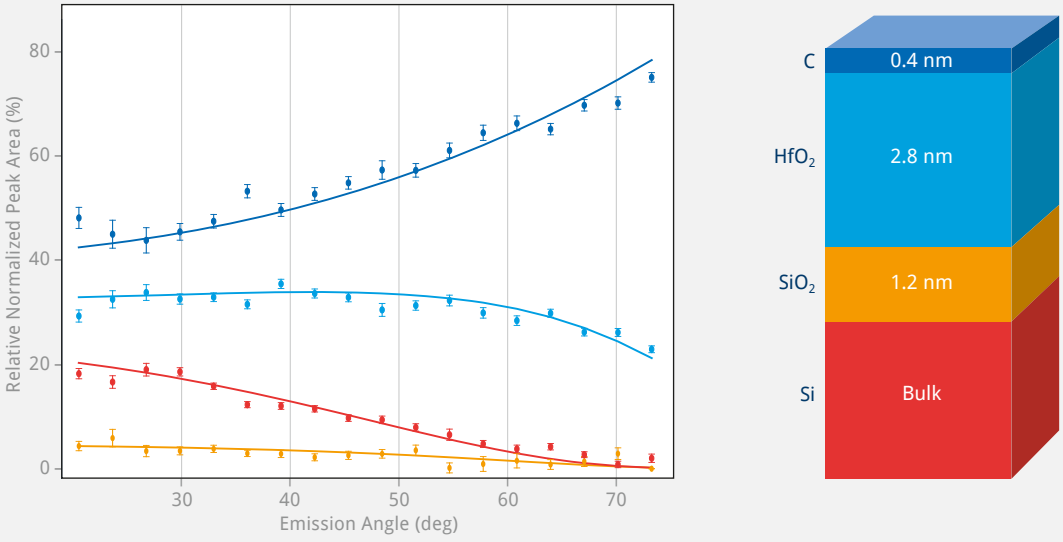
High-resolution Te 3d core-level spectra of a Sb_2Te_3 sample on Si substrate, measured with Al Kα, Ag Lα, Ti Kα and Cr Kα excitation



ical challenges because it enables depth-selective operando and in situ analysis of solid-liquid, solid-gas, and solid-solid interfaces. Dynamic reactions like oxidation, reduction, formation or consumption of compounds can be tracked in real-time. It becomes possible to monitor chemical shifts of functional materials as a direct function of for example applied temperature, reactive gas environments or ambient pressures.

System Integration

The µFOCUS 450 represents a major advancement for modern XPS/HAXPES measurement systems. Paired with a suitable electron analyzer for UHV or NAP operation, it enables faster, higher-quality, and more versatile analysis. Whether integrated into an optimized ProvenX system, an EnviroMETROS metrology tool, or a fully customized solution, the µFOCUS 450 elevates system capability to a new level.

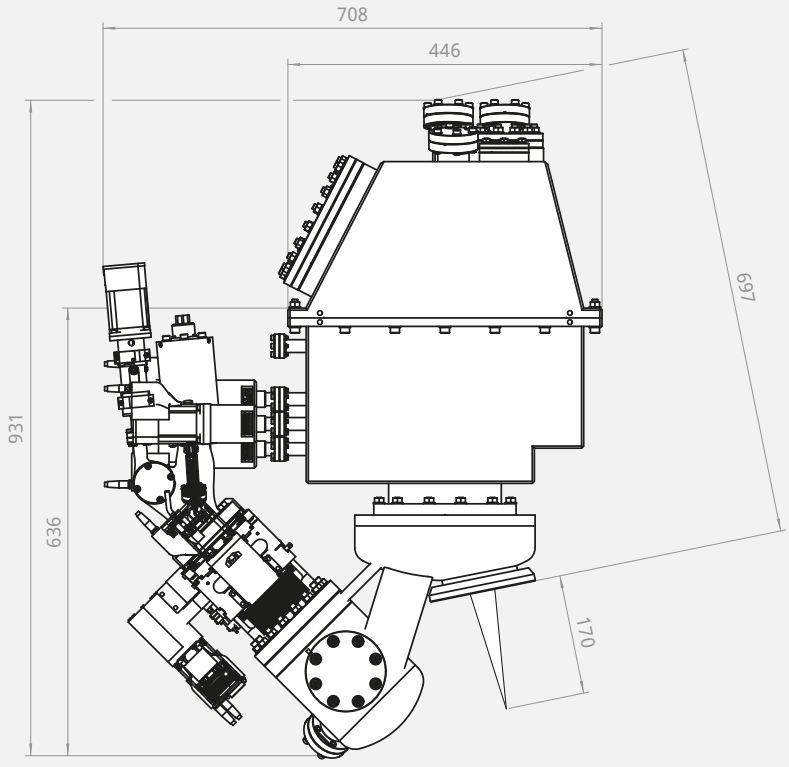


Two layer thin film on Si-wafer, depth profile gate oxide; measured with AEOLOS 150 wide angle analyzer

Technical Data

Specification	Al K_α	Ag L_α	Ti K_α	Cr K_α
Photon Energy	1487 eV	2984 eV	4511 eV	5414 eV
Minimum Spot Size	< 100 µm	< 100 µm	< 150 µm	< 200 µm
Maximum Spot Size	500 µm	500 µm	500 µm	500 µm
Flux (Ph/s) at maximum Power	7.5×10^{10}	2×10^{9}	1.4×10^{10}	8×10^{9}
Flux (Ph/s) at smallest Spot Size	8×10^{9}	5×10^{8}	3.6×10^{9}	2×10^{9}
X-ray Line width (FWHM)	< 220 meV	< 400 meV	< 450 meV	< 450 meV
Rowland Circle	450 mm	416 mm	383 mm	676 mm

Dimensions



µFOCUS with chromium extension; dimensions in mm

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