HAXPES Lab
A window to the bulk

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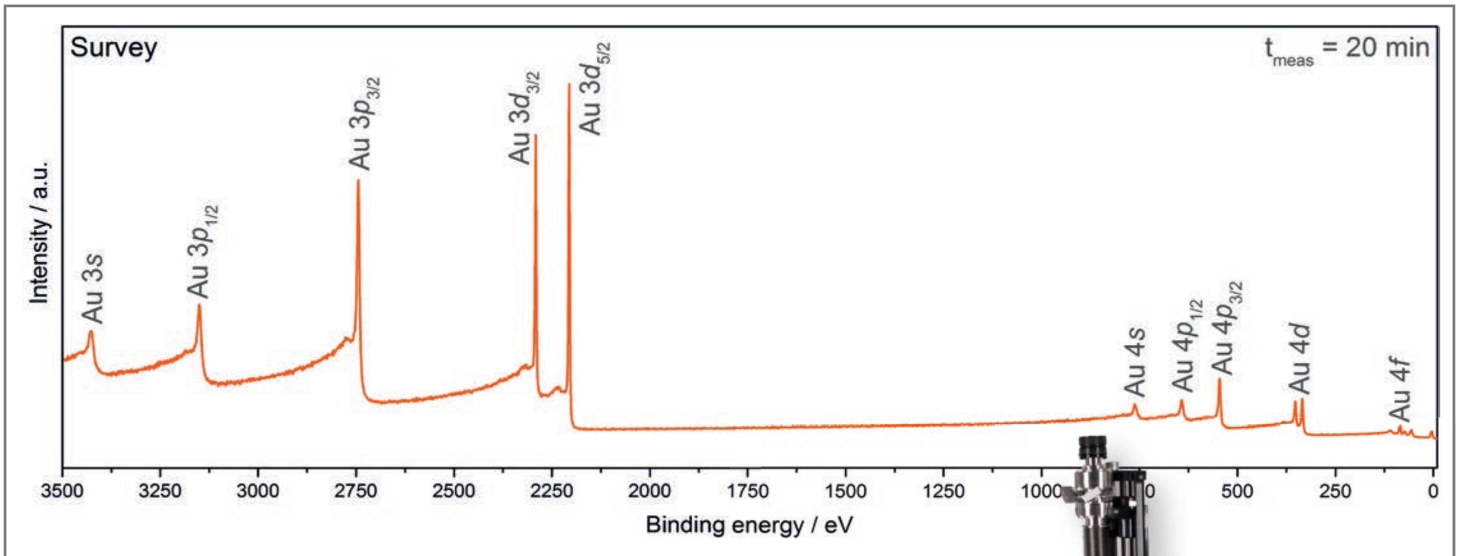
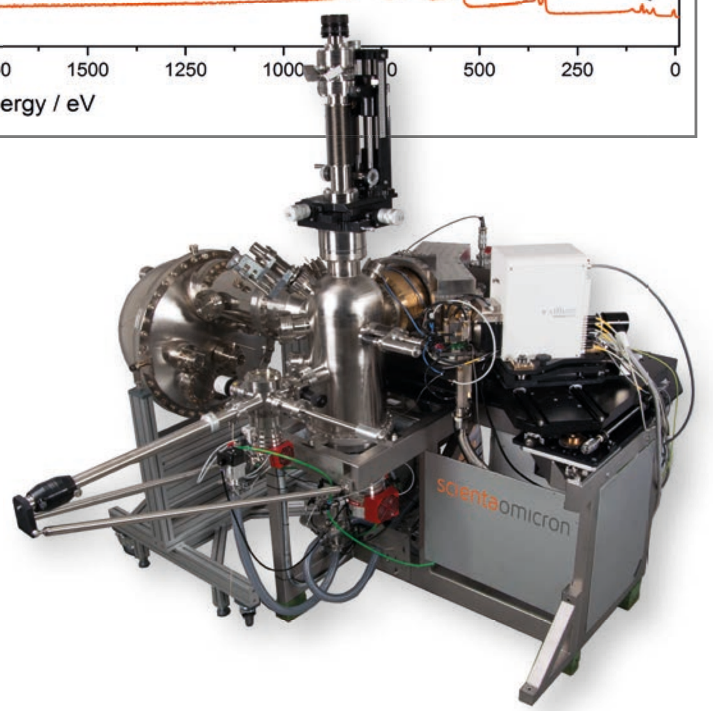


- Robust laboratory based HAXPES solution
- Time scales comparable to synchrotron experiments
- Five times higher information depth than AlKα X-Rays
- High flux monochromated Hard X-rays at 9.25 keV
- Access to deep core levels
- Non-destructive measurements of buried interfaces
- Bulk sensitive photoemission spectroscopy



HAXPES Lab
A window to the bulk

Scienta Omicron's HAXPES Lab brings hard X-ray photoelectron spectroscopy (HAXPES) capability directly to the local laboratory environment. This novel system probes bulk sample properties and accesses deep core level electrons via photoelectron spectroscopy (XPS) without the need for a synchrotron end station. Using world class technology and expert engineering, the HAXPES Lab sets the standard for laboratory based high energy photoelectron spectroscopy.

Photoelectron spectroscopy is a well-established tool for analyzing a wide range of chemical and material properties. Traditional photoelectron spectroscopy instruments employ low energy X-ray sources limiting the kinetic energy of the photo-emitted electrons. Low kinetic energy electrons have short inelastic mean free paths (IMFP), confining analysis by traditional instruments to the top several nanometers of a material's surface. HAXPES, using higher kinetic energies, greatly extends the analysis depth.

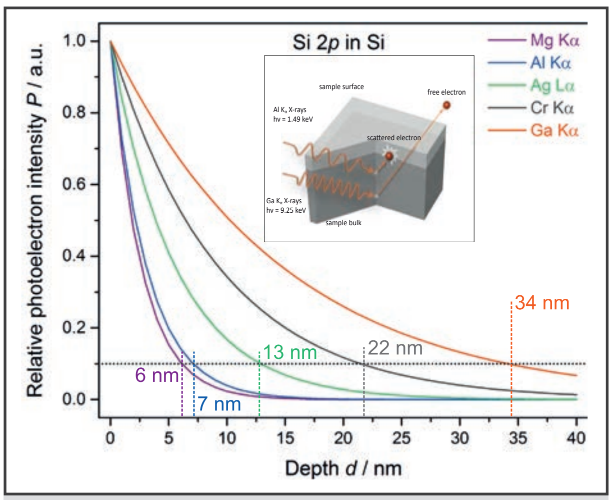
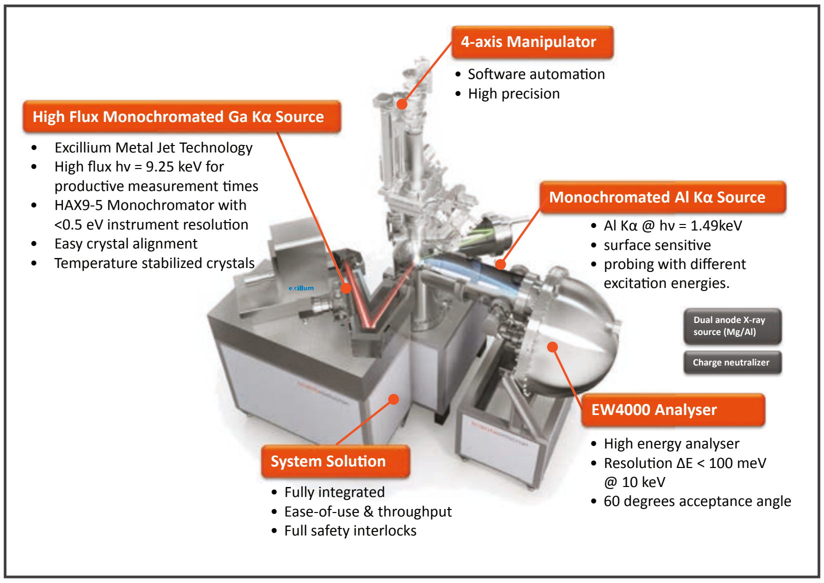


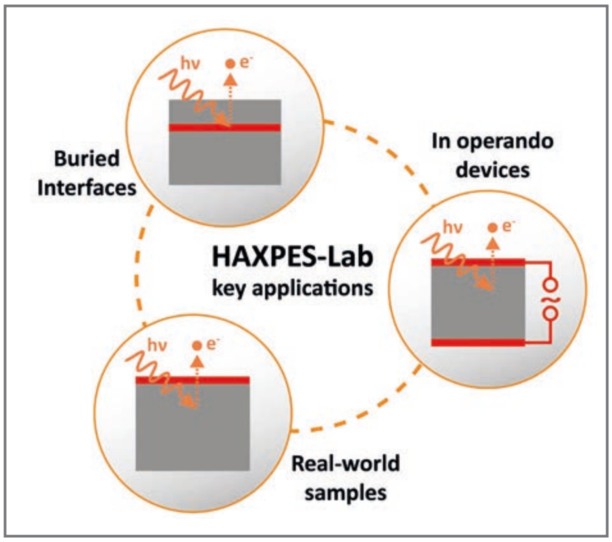
Figure 1. HAXPES using the Ga source offers 5x greater information depth, providing bulk sensitivity that is unavailable using conventional XPS.



While HAXPES measurements have been successfully deployed at synchrotrons, obtaining access to the required end stations is a significant challenge. The HAXPES Lab solves this problem and serves as a complete analytical tool by bringing cutting edge HAXPES directly to the end user's laboratory. Complimentary soft X-ray sources and charge neutralization are available. A comparison (shown left) between different lab sources highlights the information depth advantage the Ga source provides. Information depth is defined as the region in which 90% of the total signal originates. Beyond this advantage the monochromated Ga X-ray source provides higher flux than alternative hard X-ray lab sources.

HAXPES Lab:

- Practical laboratory based HAXPES measurements on synchrotron time scales
- Sensitive to surface and bulk chemical and electrical properties
- Proven state-of-the-art technology ensures staying at the forefront of materials research
- Increased information depth capabilities provide unparalleled opportunities to explore new physics and produce high impact science



Analysis at the forefront of materials research

The HAXPES Lab places the user at the forefront of materials research with its novel analytical capabilities. Unprecedented measurements of bulk electrical and chemical properties are now possible. Users can easily execute a chemical analysis of real world samples without the need for destructive and artifact inducing surface preparation steps.

This capability is critical for many high impact measurements, including properly analyzing buried layers in energy harvesting devices and batteries. Shown below is a deep core Ti1S spectra from a single crystal rutile sample with a binding energy of 4969.7 eV. This measurement was acquired by HAXPES Lab in 35 minutes.

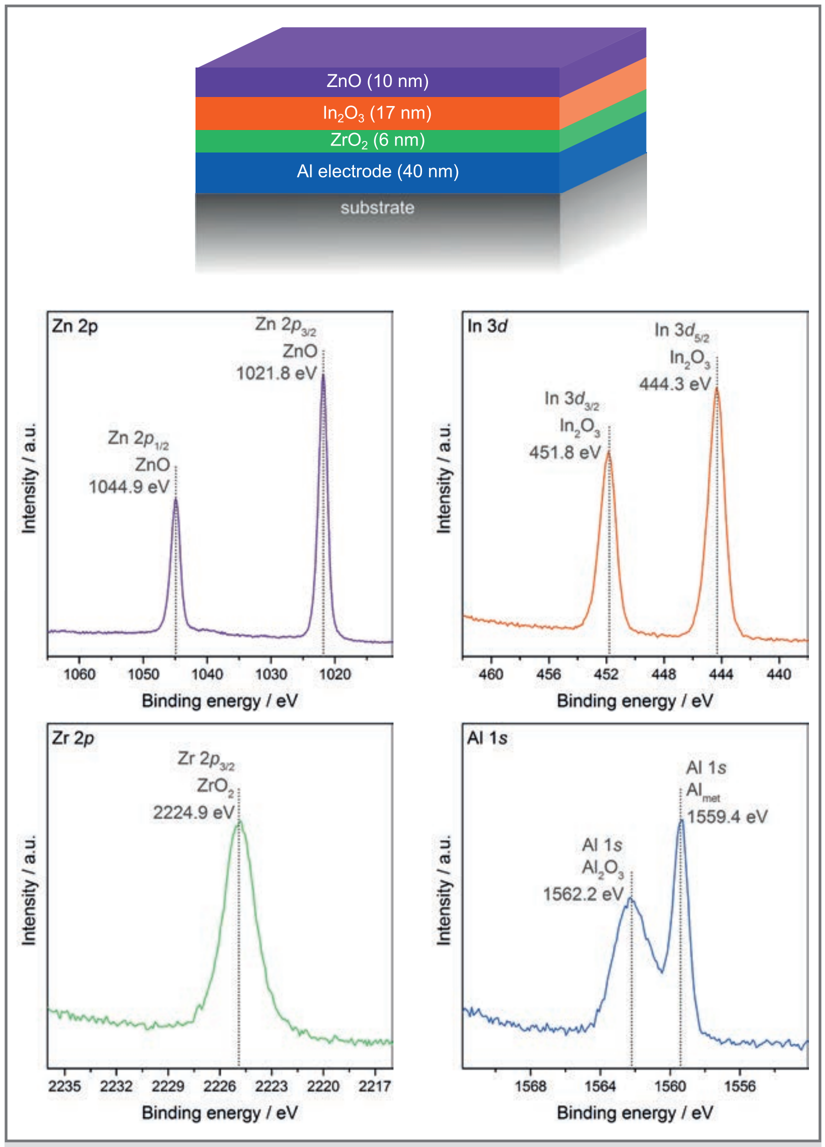


Figure 3: Complex oxide transistor stack analysis acquired in 2-4 hours. The figures show the different core levels (including deep levels) with the Al 1s peaks from 33 nm deep clearly resolved.

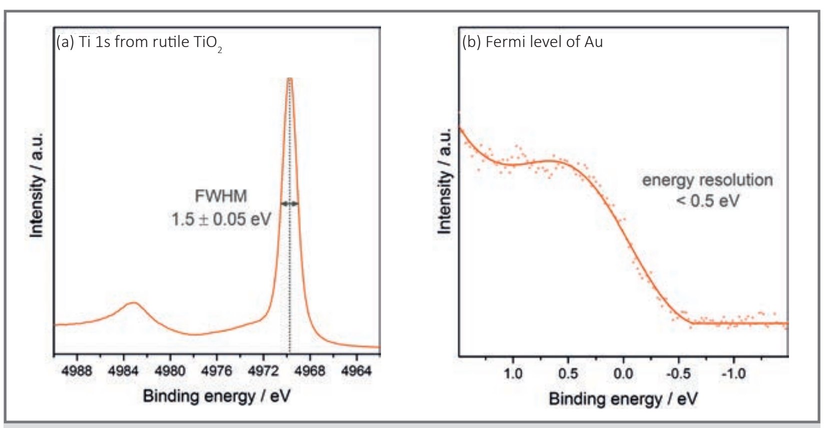


Figure 2 (a) HAXPES Lab provides unprecedented access to deep core levels, as shown in this example of a Ti 1s spectrum. (b) Fermi edge of Au shows total instrument resolution <0.5 eV.

The HAXPES Lab brings this new information to researchers while providing total instrument energy resolution of <0.5 eV. The system can be equipped with a monochromated Al Kα source for complementary XPS operation. A real-world HAXPES Lab example analysis is shown above on a complex oxide transistor stack. This structure exploits the presence of a 2D electron gas at the interface between the In_2O_3 and ZnO. Al 1s peaks are measurable, even when the Al is buried 33 nm deep. Core level Zr and In peaks, unmeasurable with standard XPS, are easy to find. These measurements were taken over 2-4 hours, thus proving the practical capabilities of the HAXPES Lab.

Analyzing buried interfaces

The higher penetration depth of Ga Kα X-rays is exploited by the high intensity of the Excillum Ga liquid jet source providing the greatest depth sensitivity from any laboratory hard X-ray system. As shown in the example at right, the metal silicon peak is still visible through 50 nm of SiO_2. Chemical information from deeper into the bulk than possible from Al or Cr based sources is possible in the HAXPES Lab with efficient time scales.

The HAXPES Lab's compact design ensures that it is an efficient solution for laboratory based measurements. Fast and simple sample introduction is matched with a motorized analysis stage, resulting in an efficient and easy to use system. Scienta Omicron's worldwide service network provides ready support for our customers in all major markets.

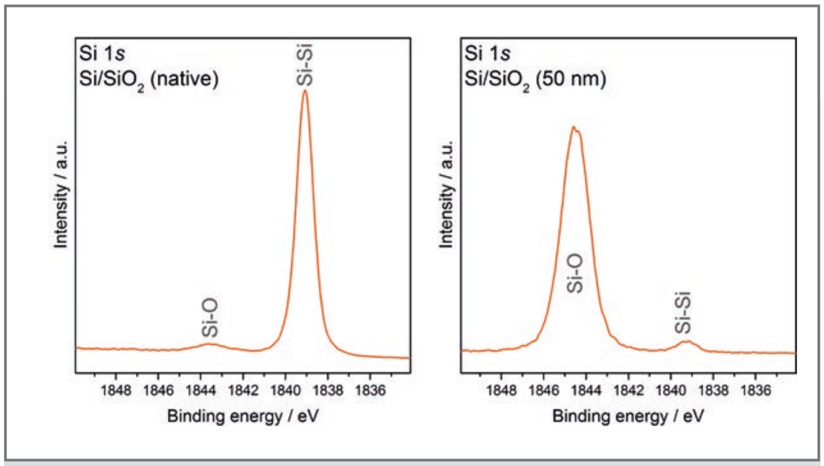


Figure 4. Si 1s spectra from native silicon with one monolayer of SiO_2 compared to spectra of silicon with 50 nm SiO_2. Measurement time is less than 8 minutes.

Technical Data

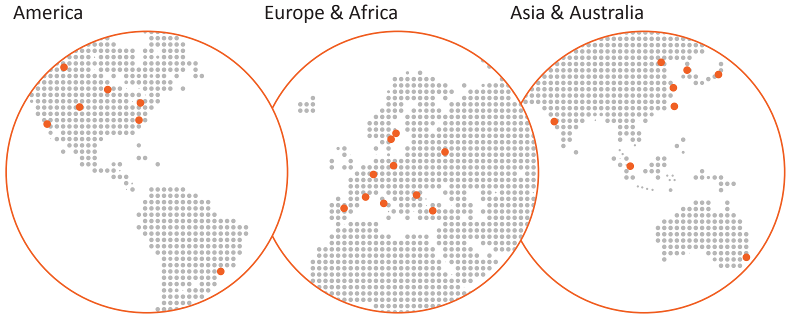
HAXPES Lab

X-ray source:	Excillum Ga liquid jet
Excitation energy:	9.25 keV
Spot size:	50 µm
Maximun power:	250 W
Total system reolsution:	<0.5 eV
Footprint:	2340*2020 mm
Base pressure:	$5*10^{-10}$ mbar

EW4000

Energy resolution:	40 meV at 6 keV 100 meV at 10 keV
Lens acceptance angle:	60º
Angular resolved range:	± 30º
Angular modes:	± 30º, ± 22º
Kinetic energy range	
Transmission mode:	5 - 10,000 eV
Angular mode:	100 - 10,000 eV
Pass Energy:	10 - 500 eV
Working distance:	40 mm
Slits	9
Detector type	MCP/CCD camera
Acquisition modes	Swept, Fixed
Detector modes	Pulsed, ADC

How to contact us



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How to contact us:
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