



# Instrumentation for surface science

Surface chemistry and thin film characterization

# X-ray Photoelectron Spectroscopy

Quantitative, chemical identification of the surface

X-ray Photoelectron Spectroscopy (XPS, also known as Electron Spectroscopy for Chemical Analysis – ESCA) is a highly surface-sensitive, quantitative, chemical analysis technique that can be used to solve a wide range of materials problems.

XPS is the measurement of photoelectrons ejected from the surface of a material which has been irradiated with X-rays. The kinetic energy of the emitted photoelectrons is measured, which is directly related to their binding energy within the parent atom; this is characteristic of the element and its chemical state.

Only electrons generated near the surface can escape without losing too much energy for detection; this means that XPS data is collected from the top few nanometers of the surface. It is this surface selectivity, coupled with quantitative chemical state identification, that makes XPS so valuable in a vast array of application areas.



# Nexsa XPS system

## Unique correlative spectroscopy

The Thermo Scientific™ Nexsa™ Surface Analysis system is a fully automated, multi-technique instrument. It features a new, micro-focus X-ray source, delivering both high sensitivity and high spatial resolution XPS. In addition, the system offers options for other surface analysis techniques: UPS, ISS and REELS. Uniquely, there is also the option to integrate a Raman spectrometer, aligned to the XPS analysis position, for true, correlative spectroscopy. With these features, Nexsa unlocks the potential for new insights in semiconductors, 2D materials, thin films, batteries, polymers and many other applications.



- High performance XPS
- Rapid SnapMap XPS imaging
- Depth profiling
- Optional multi-technique integration
  - Raman
  - ISS
  - UPS
  - REELS
- MAGCIS ion source for expanded depth profiling capabilities
- Large sample handling
- Avantage Software for instrument control, data processing, and reporting
- Optional transfer capabilities for air-sensitive samples



## High-performance XPS with seamless multi-technique integration

**From nanotechnology to polymer engineering, the questions posed by advanced materials development increasingly need a correlative approach to reach answers.**

# ESCALAB Xi+ XPS microprobe

## Performance and versatility

The Thermo Scientific™ ESCALAB™ Xi+ XPS microprobe is the latest development in our renowned ESCALAB product line. The ESCALAB Xi+ is designed as an expandable, multi-technique platform with unparalleled flexibility and configurability. System control, data acquisition, processing and reporting are seamlessly integrated by the powerful Thermo Scientific™ Avantage™ XPS software.

- High-resolution, quantitative XPS imaging for smallest feature analysis
- High-performance spectroscopy
- Ion source for depth profiling
- Flood source for insulator analysis
- Ion scattering spectroscopy (ISS) as standard
- Reflected electron energy loss spectroscopy (REELS) as standard
- Optional additional techniques:
  - Ultra-violet photoelectron spectroscopy (UPS)
  - Auger electron spectroscopy (AES)
  - Microanalysis (EDS)
- Optional MAGCIS dual mode ion source
- Full range of sample preparation options:
  - Sample heating and cooling
  - Fracture stage
  - Inert transfer



## Bringing together high-performance XPS with flexible sample preparation

The ESCALAB product line has been at the forefront of surface analysis for decades, trusted by the experts to support their cutting edge research.

# K-Alpha XPS system

## Designed for productivity

The Thermo Scientific™ K-Alpha™ spectrometer bridges the requirements for both research and routine XPS analysis. The high-performance system hardware makes the K-Alpha spectrometer ideally suited to creating world-class data in a busy R&D environment. Intuitive workflows make it possible to put the K-Alpha spectrometer into a multi-user, shared facility, allowing operators of all skill levels to add surface analysis to their materials analysis portfolio.

- High-performance, fully featured XPS system
- Unique sample viewing with capability to facilitate rapid feature identification
- Chemical state imaging
- Large sample handling
- Variable micro-focus X-ray source to match analysis area to feature
- Ion source for depth profiling
- Low energy flood source for insulator analysis
- Built-in standards for self-calibration



## Making XPS surface analysis routine

Bringing XPS into multi-user facilities, materials research & development laboratories, or production support.

# MAGCIS dual mode ion source

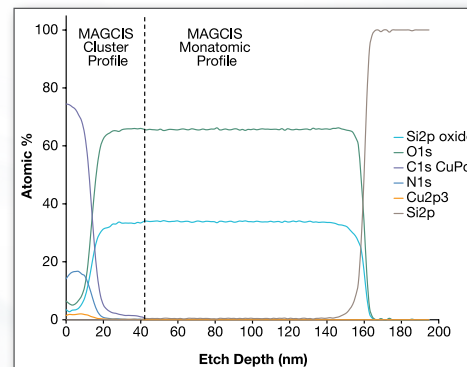
## Monatomic and gas cluster ion source option for Thermo Scientific XPS spectrometers

The Thermo Scientific MAGCIS dual mode ion source enables depth profiling analysis and surface cleaning of both soft and hard materials on the same XPS instrument. Switching between gas cluster sputtering and monatomic sputtering is handled completely by Avantage software, and can be done in a matter of seconds.

Gas cluster ion depth profiling opens up a variety of applications: investigate oil-resistant coatings on touch screens, measure plasma deposited coatings for biomedical devices, or characterize OLEDs and solar cells.

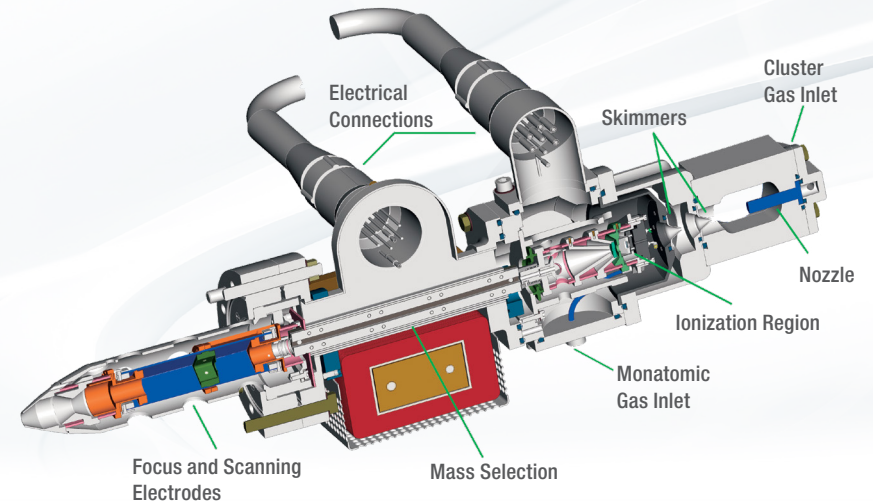
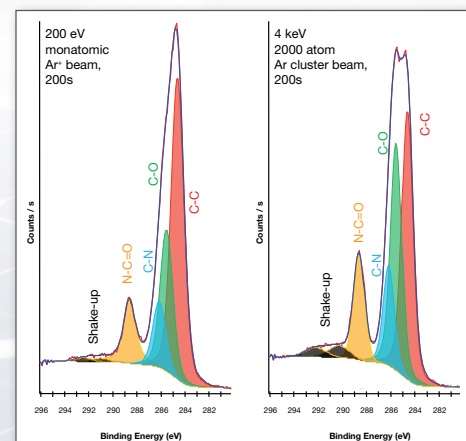
Used for decades, monatomic ion sources – typically using  $\text{Ar}^+$  as a projectile – clean surfaces and enable analysts to investigate changes in chemistry relative to depth. However, the technique has limitations as it can induce damage on certain surfaces, changing the chemistry of the material.

With the introduction of the MAGCIS dual mode ion source, you can operate as both a monatomic ion source and a cluster ion source in a single experiment and overcome these limitations. The MAGCIS ion source opens analysis of new, hitherto inaccessible, classes of materials.



▲ Depth profile of an organic FET showing both monatomic and gas cluster ion etching

► Comparison spectra of a polyimide sample showing damage (left) from  $\text{Ar}^+$  beam, while surface chemistry is retained with the Ar cluster beam (right)



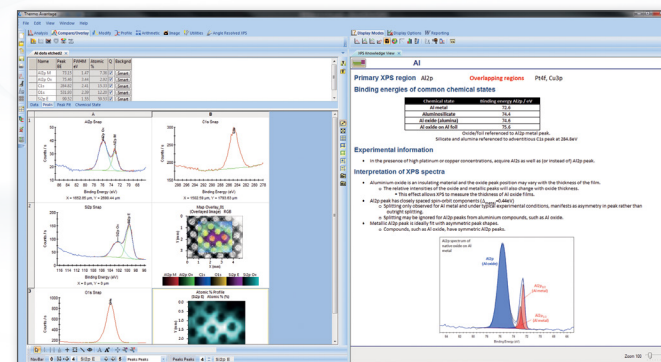
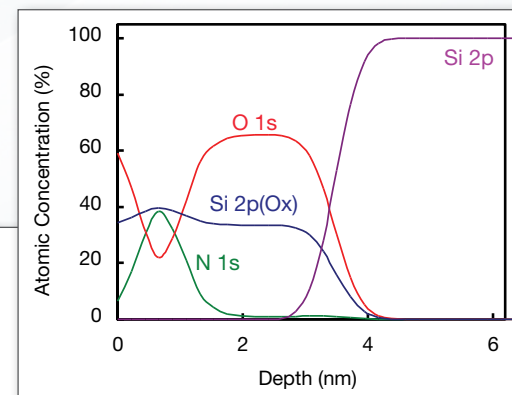
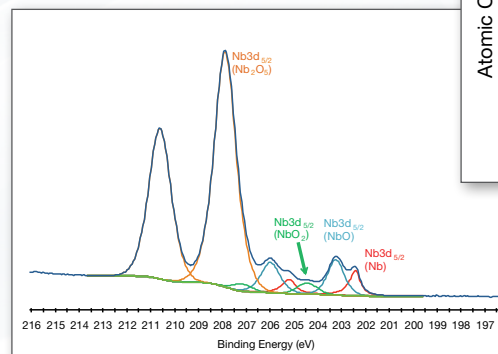
- Patented\* dual mode design
- Variable cluster size (up to 2000 atoms)
- Cluster energy/atom from 1eV upwards
- Monatomic  $\text{Ar}^+$  mode (0.5–4 keV)
- Fast, automated mode switching
- Full control through Avantage
- Automated set-up and alignment

\* GB Patent 10171713.4  
US Patent 2013/0180844 A1

# Avantage software

The premier software for surface analysis

The most crucial component of a modern XPS instrument is its software, which handles all aspects of operation, data interpretation and reporting. All Thermo Scientific XPS systems use Thermo Scientific Avantage software for instrument control, data processing, and reporting. Whether working in a dedicated research lab or in a multi-user environment, analysts of all abilities can rely on the flexibility, feature-set, and intuitive operation of Avantage software to obtain the maximum information from their samples.



- Instrument control for all Thermo Scientific surface analysis systems:
  - K-Alpha XPS system
  - ESCALAB Xi+ XPS microprobe
  - Nexsa XPS system
- Fully-flexible experiment design, including multi-technique integration
- Automated data acquisition including data processing functions and reporting
- Thermo Scientific™ Knowledge View™, references and intelligent algorithms for data interpretation
- Advanced data reduction tools
- Easy export to reporting software



The full spectrum of surface analysis



	K-Alpha	ESCALAB Xi+	Nexsa	
<b>XPS capabilities</b>	Large area XPS	●	●	●
	Small area XPS	●	●	●
	XPS imaging	●	●	●
	SnapMap	●		●
	Charge compensation system for insulator analysis	●	●	●
	Ion Source for depth profiling	●	●	●
	Angle dependent XPS	◐	●	◐
	Automated sample transfer	●		●
<b>Selected analytical options</b>	Raman spectroscopy			◐
	MAGCIS dual mode ion source		◐	◐
	Reflected electron energy loss spectroscopy (REELS)		●	◐
	Low energy ion scattering spectroscopy (ISS/LEIS)		●	◐
	UV Photoelectron Spectroscopy (UPS)		◐	◐
	Auger Electron Spectroscopy & EDS		◐	
	Sample preparation options		◐	
	Inert sample transfer	◐	◐	◐

Included ● Optional ◐

The Thermo Scientific Surface Analysis portfolio has the right tool for your work and your budget. For those seeking performance and value, there is the K-Alpha. If you need custom capabilities, then the ESCALAB Xi+ can meet your requirements. For those needing cutting edge XPS capabilities, with analytical options tailored to your sample requirements (including the unique Raman spectroscopy offering), then it must be Nexsa.

Find out more at [thermofisher.com/xps](http://thermofisher.com/xps)