

**Thermo Scientific K-Alpha<sup>+</sup>**  
XPS Spectrometer



# Fast, powerful and accessible chemical analysis

for surface and thin film characterization

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# 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, which makes XPS so valuable.

## Key Application Areas

- **Glass Coatings**
- **Polymers**
- **Batteries**
- **Graphene**
- **Solar Cells**
- **OLEDs**
- **Metals and Oxides**
- **Bio-surfaces**
- **Thin Films**
- **Semiconductors**
- **Ceramics**
- **Catalysts**

# K-Alpha<sup>+</sup> XPS Spectrometer

*Designed for performance and productivity*

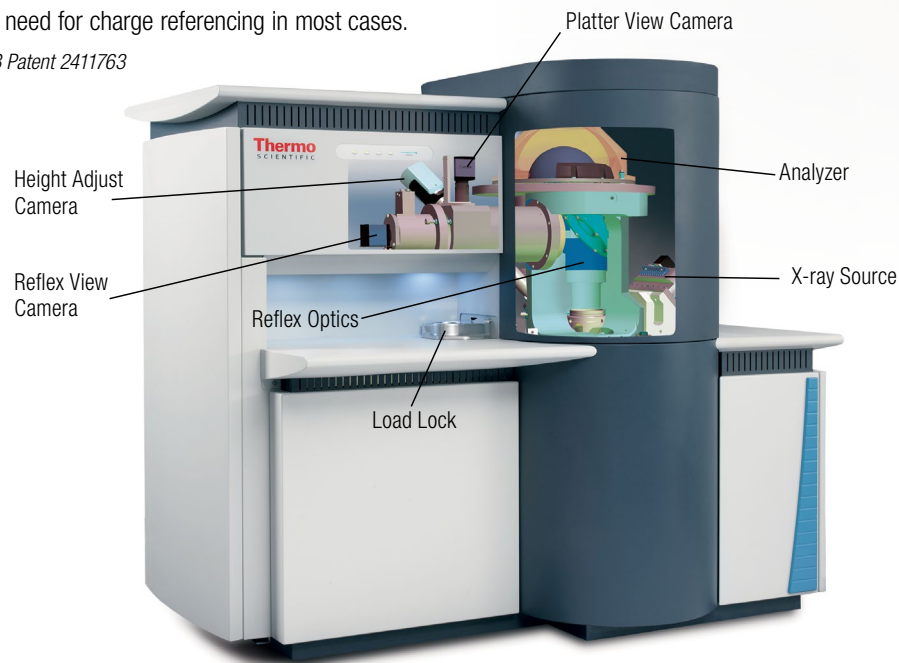
## High Performance Spectroscopy

The Thermo Scientific™ K-Alpha<sup>+</sup>™ X-ray photoelectron spectrometer features a low power, high performance X-ray monochromator that allows the operator to select an analysis area from 30 μm to 400 μm in 5 μm steps, ensuring that the analysis area can be tuned to the feature of interest to maximize the signal. The high efficiency electron lens, hemispherical analyzer and multi-channel detector allow for superb detectability, and rapid data acquisition.

## Insulator Analysis

The single-click charge compensation system on the K-Alpha<sup>+</sup> spectrometer makes insulator analysis as easy as any other sample. The patented\* dual-beam flood source is designed to prevent sample charging, using very low energy electrons and ions, which eliminates the need for charge referencing in most cases.

\* GB Patent 2411763

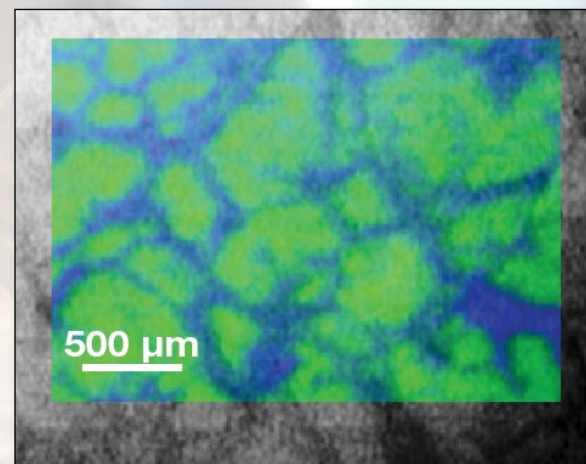


## Chemical State Imaging

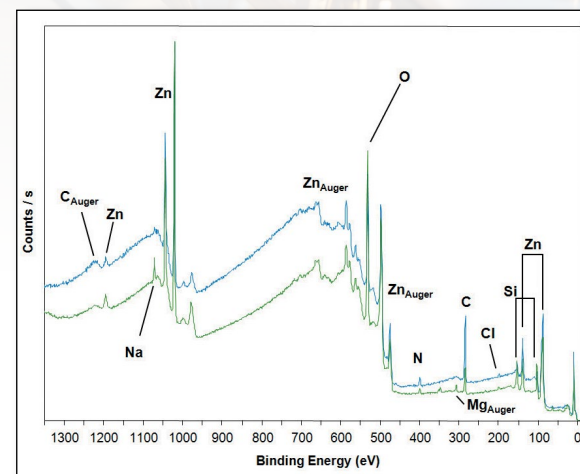
The K-Alpha<sup>+</sup> spectrometer is capable of creating chemical state images of the surface, from investigating small features, to imaging samples sized as large as the stage platen itself. The unique optical viewing system offers the opportunity to overlay XPS maps with stored camera images, creating a powerful tool for identifying and quantifying distributions of surface chemistries.

## Depth Profiling

The K-Alpha<sup>+</sup> spectrometer is built to go beyond the surface with the standard ion source or with Thermo Scientific™ MAGCIS™ – the optional dual mode monatomic and gas cluster ion source. Automated source optimization and automated gas handling ensures excellent performance and experimental reproducibility.



K-Alpha<sup>+</sup> atomic concentration image of organometallic matrix on glass



Survey spectra from blue and green phases in the image

# Making Research Routine

*Precise results, quickly and efficiently*

The K-Alpha<sup>+</sup> spectrometer bridges the requirements for both research and routine XPS analysis. Cutting edge performance of the system hardware, with the opportunity to add revolutionary new capabilities such as the Thermo Scientific MAGCIS (Monatomic And Gas Cluster Ion Source), makes the K-Alpha<sup>+</sup> spectrometer ideally suited to creating world-class data in a busy R&D environment. Intuitive instrument operation, guided by the Thermo Scientific™ Avantage™ data system, makes it possible to put the K-Alpha<sup>+</sup> spectrometer into a multi-user, shared facility, allowing operators of all skill levels to add surface analysis to their materials analysis portfolio.

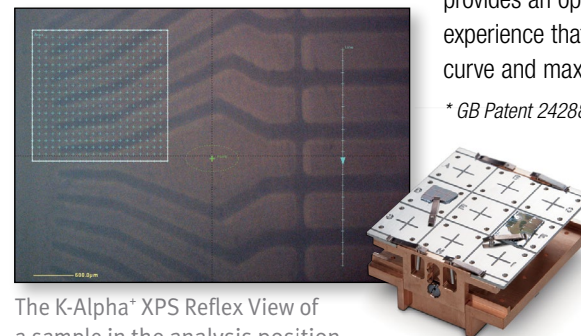
## Calibration

An XPS instrument is only as good as its calibration. The K-Alpha<sup>+</sup> spectrometer is supplied with the necessary standards for calibration, permanently mounted inside the analysis chamber. A single button press in the software, and the K-Alpha<sup>+</sup> system will self-calibrate in minutes, ensuring confidence in the quality of your data.

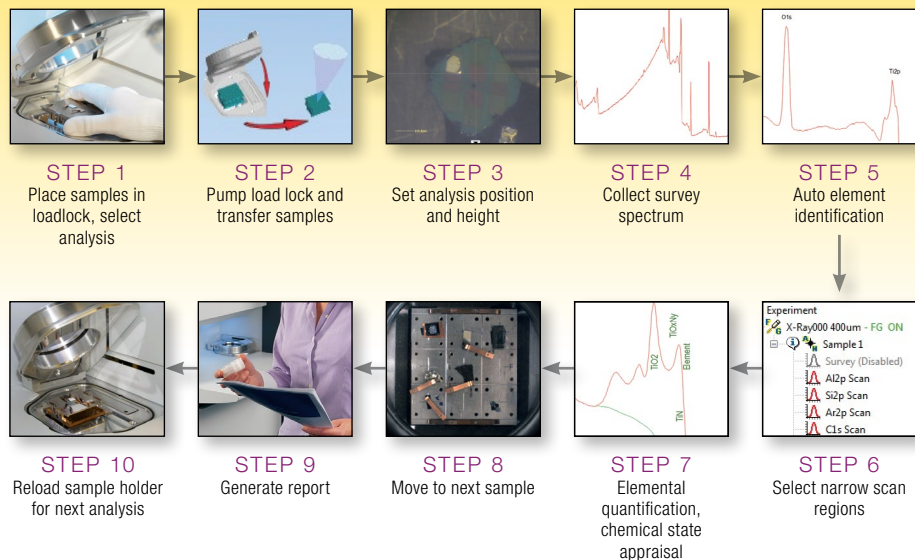
## Sample Navigation

Three cameras provide an unmatched view of the sample. The patented\* reflex optics give the ultimate confidence in the analysis position, the second camera in the analysis chamber makes aligning small features fast and intuitive, and the load-lock camera speeds you from sample-to-sample. Together, the K-Alpha<sup>+</sup> spectrometer provides an optically-driven user experience that minimizes the learning curve and maximizes productivity.

\* GB Patent 2428868



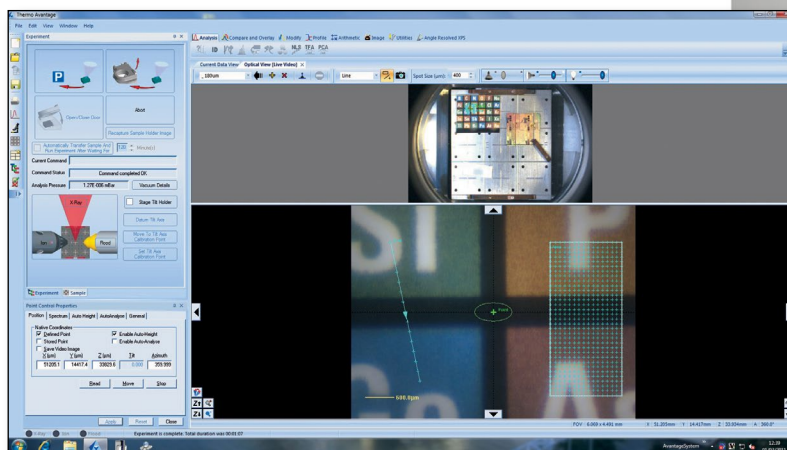
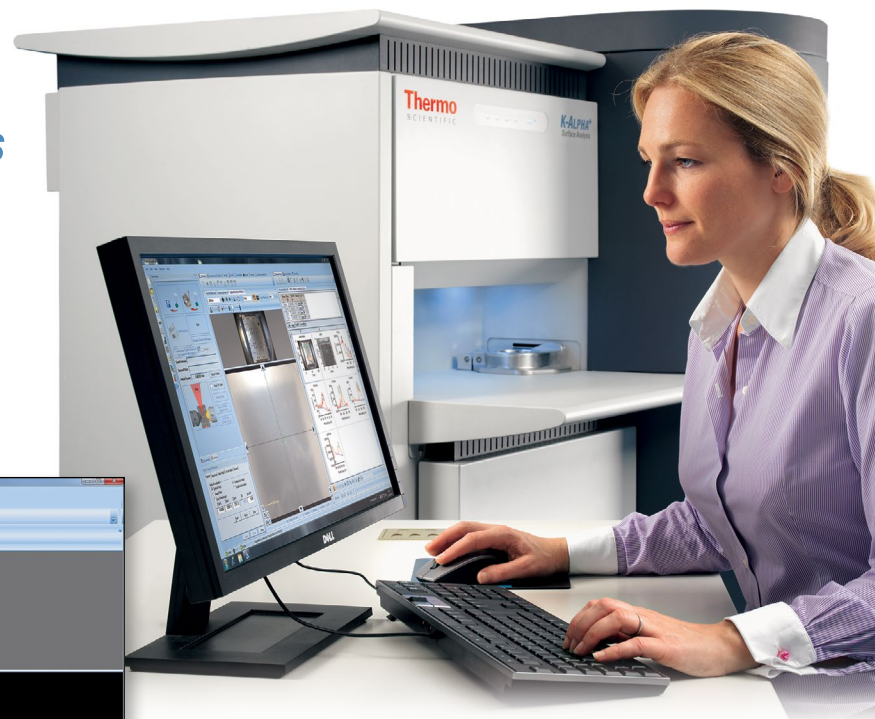
The K-Alpha<sup>+</sup> XPS Reflex View of a sample in the analysis position



# Avantage Software

*The premiere software for surface analysis*

The most crucial component of a modern XPS instrument is its data system. The K-Alpha<sup>+</sup> spectrometer – like all Thermo Scientific XPS systems – uses Thermo Scientific Avantage software for instrument control, data processing, and reporting. Whether working in a dedicated research lab or as a tool in a multi-user environment, Avantage software provides the flexibility, feature-set, and intuitive operation to enable users of all abilities to obtain the maximum information from their samples.



## Control

From the moment samples are loaded into the system, Avantage software manages all the instrument operations. Samples are pumped down, and transferred into the analysis chamber automatically, under the protection of multiple safety interlocks. Avantage monitors all system parameters, storing the data to keep a record of the performance of every system component, and can automatically calibrate the K-Alpha<sup>+</sup> spectrometer with a single button press. User-level control, integrated with Microsoft® Windows®, allows functions to be enabled or disabled based on user ability or access requirements.

## Acquire

Data acquisition could not be simpler. Choose the analysis point, depth profile, line or area from the optical view or the platen view, set the analysis area to match the feature of interest, from the periodic table define the elements of interest, and start the experiment.

Complex experiments are ready to run in no time. Program multiple positions and experiment types into the same experiment to create long, unattended runs on large sample sets. Sensible default parameters and automated analysis routines allow the K-Alpha<sup>+</sup> spectrometer to assist inexperienced operators, guiding them through the analysis process all the way to generating a report.

## Analyze

Use a large selection of data processing tools to get the maximum information from your samples. Basic tools quantify individual spectra, while powerful peak deconvolution routines and sophisticated multivariate statistical analysis tools create images and depth profiles. Avantage is designed to assist users of all abilities. Interactive reference guides assist with spectrum interpretation, reference spectra, and peak-fit schemes that move you from data to results – fast.

## Report

Copy and paste numerical data, or spectra and images into other software, or write automatically to Microsoft® Office.

# Optional Accessories

## *Extend your sampling capabilities*

Accessories extend the capabilities of the K-Alpha<sup>+</sup> spectrometer. They enable users to transfer samples prepared in an inert environment into the K-Alpha<sup>+</sup> spectrometer chamber, determine the work function of the material at the surface, and collect angle-dependent XPS data from multi-layered structures.

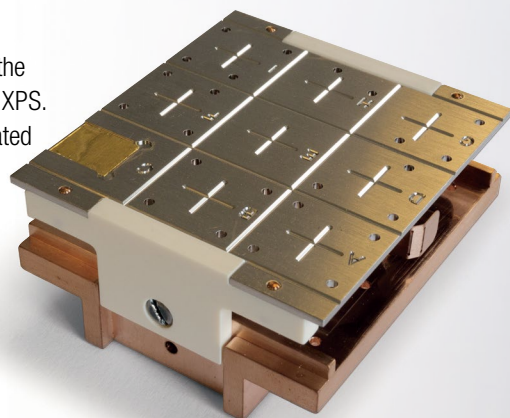


### **Tilt Module**

The tilt module facilitates the collection of angle-dependent XPS data. Coupled with the processing tools within the Avantage software, the tilt module enables experiments from simple overlayer calculations to complex multi-layer structure determination and measurement.

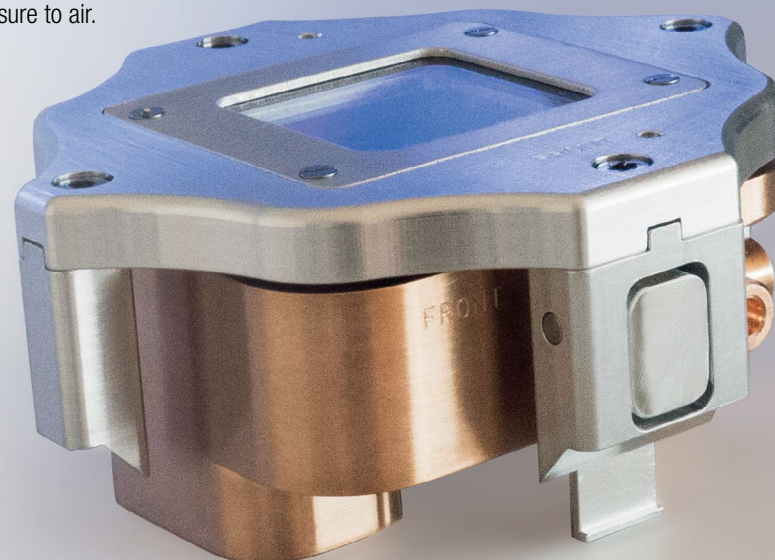
### **Sample Bias Module**

The bias module provides an electrical connection to the sample area, allowing the measurement of the work function using XPS. By using the micro-focused monochromated X-ray source, small area, line scan, and even maps can be generated to determine the work function of the material across the surface.



### **Vacuum Transfer Module**

The vacuum transfer module allows samples that have been prepared in an inert environment to be transferred into the spectrometer chamber without exposure to air.



# MAGCIS

## Dual Mode Ion Source

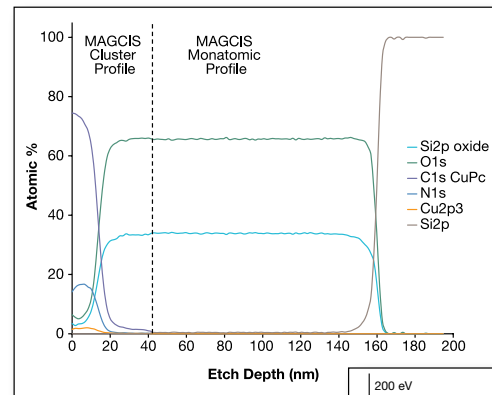
*Monatomic and Gas Cluster Ion Source*  
*...the future of depth profiling*

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.

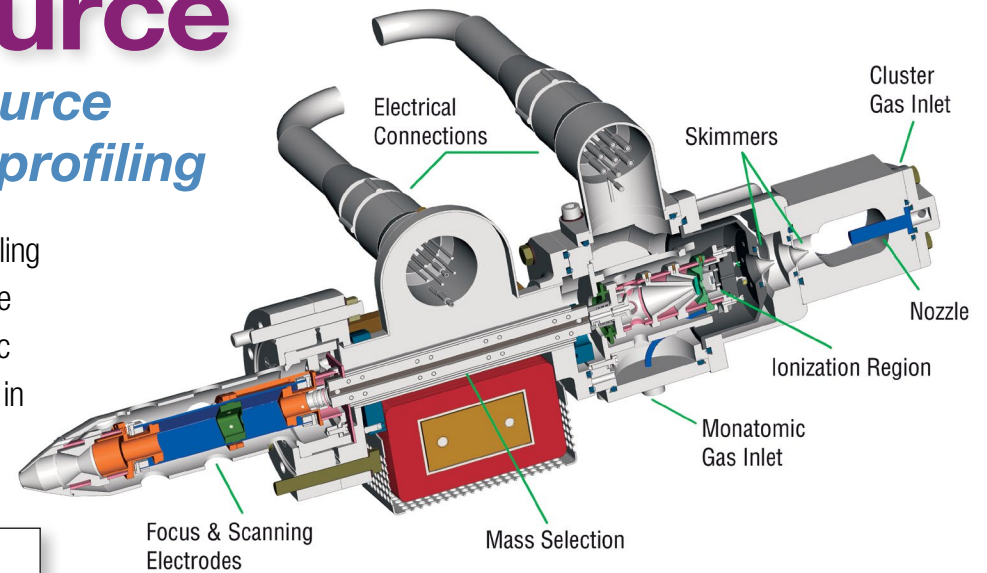
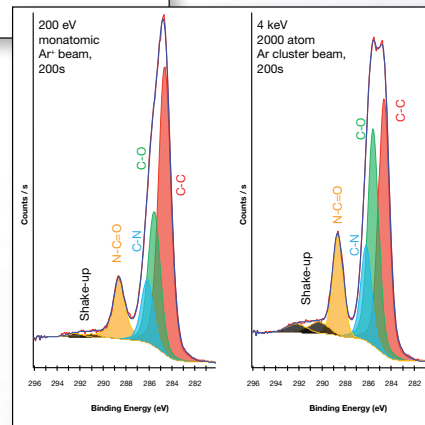
Used for decades, monatomic ion sources – typically using  $\text{Ar}^+$  as a projectile – clean surfaces and enable analysts to investigate changes in chemistry relative to depth. However, the technique has limitations as it can induce damage on certain surfaces, changing the chemistry of the material.

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  $\text{Ar}$  cluster beam (right)



### MAGCIS Features

- **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

# K-Alpha<sup>+</sup> Spectrometer Configuration

## Analyzer

- 180° double focusing hemispherical analyzer
- High-efficiency electron transfer lens
- 128-channel detector

## X-ray Source

- Al K $\alpha$  micro-focused monochromator
- Variable spot size (30–400  $\mu\text{m}$  in 5  $\mu\text{m}$  steps)
- High-performance with low power (maximum 72W)

## Charge Compensation

- Dual-beam source
- Ultra-low energy co-axial electron and Ar<sup>+</sup> ion beam

## EX06 Ion Gun

- Energy range 100 eV to 4 keV

## Sample Handling

- 4-axis sample stage
- 60 × 60 mm sample area
- 20 mm maximum sample thickness

## Vacuum System

- Two 250 l/s turbo molecular pumps
- Auto-firing, 3 filament TSP

## Software

- Avantage software including offline data processing

## Options

- MAGCIS – Monatomic And Gas Cluster Ion Source
- Tilt module for ARXPS
- Vacuum transfer module for air-sensitive samples
- Sample bias module for work function measurements
- Interface to connect to glove box



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