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HIGH-RESOLUTION ANALYSIS OF SURFACES USING COMBINED XPS AND SEM

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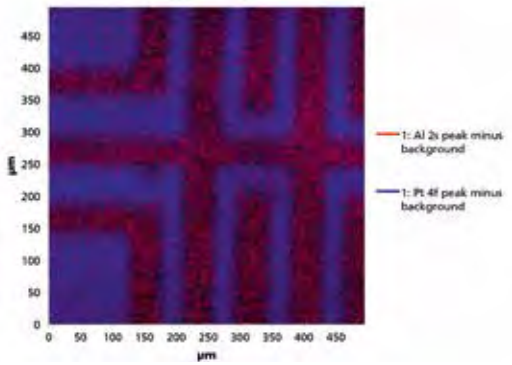
SURFACE ANALYSIS FOR MATERIAL DEVELOPMENT AND DAMAGE ANALYSIS

The verification of surface properties is of great importance in many application areas. Whether priming, bonding, corrosion protection, friction reduction, optics – even the surfaces of simple functional components are in most cases adapted to their further use.

In addition to the obvious application purpose, the coating processes are often complex and adapted to the material and geometry. Since all manufacturing steps leave traces on the surface of a component, e.g. residues of release agents adhere over part of or the entire surface, even the slightest deviations can cause problems such as failing adhesion, peeling of coatings, lack of electrical conductivity and much more. This may be caused by contaminations that can only be detected at the atomic level.

The methods presented in this brochure make it possible to detect the composition of surfaces with great sensitivity. This begins with an ion scattering method that reacts to the uppermost atomic layer and ranges from Auger and photoelectron spectroscopy (nanometer range) to EDS, which provides an insight in the micrometer range.



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RANGE OF SERVICES

Fraunhofer IGB offers a Kratos Axis Supra with the latest generation XPS for surface analysis, which has been individually extended by a UPS, a scanning electron microscope and a scanning auger microscope. If a higher surface sensitivity is required, the element composition can be measured at atomic level via ion scattering. Electron energy loss spectroscopy can also be used to determine the hydrogen content of a sample. The device also has an argon ion cluster source for producing depth profiles.

We would be happy to discuss your questions and requirements with you and make you an individual offer.

FIELDS OF APPLICATION

We investigate the surface chemistry, topography and morphology in order to support your material development, or to identify potential sources of error. Due to the integration of various methods in one device, we can use them in a complementary way – by combining chemical analysis and high-resolution imaging procedures with absolute precision.

	Chem. elements	Chem. bond
XPS	•	•
AES / SAM	•	(•)
REM / EDS	•	
UPS		
REELS	(•)	(•)
ISS	•	

TESTING METHODS

- **ESCA, XPS:** X-ray photoelectron spectroscopy, also: electron spectroscopy for chemical analysis. Determination of element concentrations and chemical bonds within the top 10 nanometers. The surface sensitivity can be increased by angle-resolved measurements (ARXPS).
- **AES:** Auger electron spectroscopy. With this method, the element concentrations of the uppermost nanometers are analyzed, the lateral resolution is higher than with XPS.
- **SAM:** Scanning auger microscopy. See AES, but imaging mode.
- **SEM:** Scanning electron microscopy. Image of a material surface using a focused electron beam.
- **EDS, EDX:** Energy dispersive X-ray spectroscopy, also: X-ray microanalysis. This method is used in conjunction with SEM and delivers the element composition down to micrometer material depth. The lateral resolution corresponds to that of SEM.
- **UPS:** Ultraviolet photoelectron spectroscopy. The valence electrons in the sample are excited by UV light, which is used for valence band spectroscopy.
- **REELS:** Reflective electron energy loss spectroscopy.
- **ISS:** Ion scattering spectroscopy.

Valence band	Spatial resolution	Depth of information
	1 µm (imaging), 15 µm small spot	approx. 10 nm
	< 0.5 µm	< 3 nm
	< 0.5 µm	µm
•	(•)	nm
	< 0.5 µm	approx. 10 nm
	(•)	atomic top layer

EQUIPMENT AND SAMPLE MATERIAL

- XPS/UPS
  - X-ray sources: Al Kα (1486.6 eV) and Ag Lα (2984.2 eV)
  - UV source: Helium discharge, He I = 21.22 eV and He II = 44.8 eV
  - Delay line detector for spectroscopy and imaging
- Ion sputter gun for argon ions and argon clusters
- SEM/EDS/AES/SAM/REELS:
  - Field emission cathode (2 keV/10 keV)
  - REELS detector
  - EDS detector
- ISS source and detector
- Sample temperature control from –100 °C to 800 °C

All vacuum-resistant materials can be measured. The samples can be cooled down to –100 °C so that sample components that are volatile at room temperature can also be measured.

1 *XPS image.*

2 *Measuring system "Kratos Axis Supra".*

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