METROVAC
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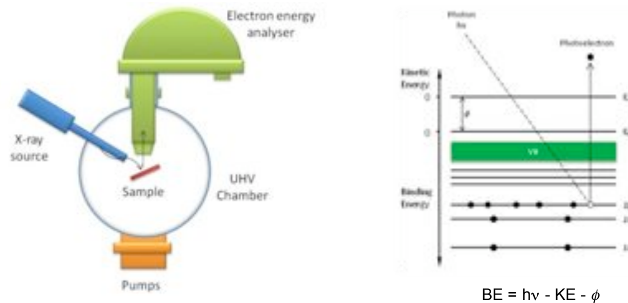
analytical services:

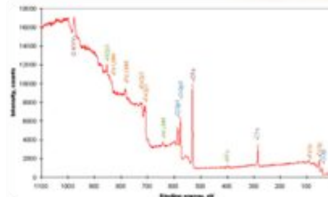
XPS – X-ray Photoemission Spectroscopy

A chemical analysis technique that provides surface elemental analysis and chemical bonding information. Minimal sample preparation is required, and non destructive depth information can be obtained. Compositional depth profiles can also be obtained by sputtering through the desired layers during analysis.



BE = hν - KE - ϕ

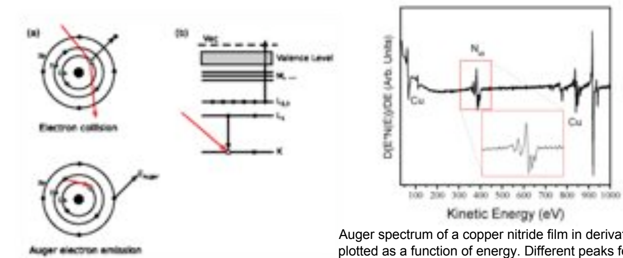
In XPS analysis, the sample is placed in an ultrahigh vacuum environment and exposed to a low-energy X-ray source. The X-ray excitation causes the emission of photoelectrons from the atomic shells of the elements present on the surface.
The energy of these electrons is characteristic of the element from which they are emitted.
The area under peaks in the spectrum is a measure of the relative amount of each element present, and the shape and position of the peaks reflect the chemical state for each element.



Survey spectrum of stainless steel

AES – Auger Electron Spectroscopy

Auger Electron Spectroscopy (AES, Auger) is a surface-specific analytical technique that utilizes a high-energy electron beam as an excitation source. Atoms that are excited by the electron beam can relax under the emission of "Auger" electrons. AES measures the kinetic energies of the emitted Auger electrons, which are characteristic of elements present at the surface and "near-surface" of a sample.

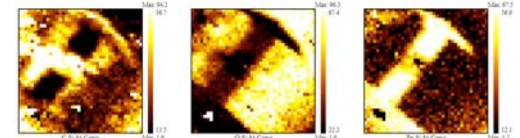


Auger spectrum of a copper nitride film in derivative mode plotted as a function of energy. Different peaks for Cu and N are apparent with the N KLL transition highlighted.

SAM - Scanning Auger Microscopy

This technique enables images of the elements in the near surface layer of conducting samples to be acquired. SAM a combination of the techniques of SEM and AES. An electron beam is scanned over the surface and the electrons excited from the surface are energy analyzed to detect Auger peaks.

Auger image maps of carbon, oxygen and zinc from a zinc oxide sample. The zinc oxide film was deposited by PVD on a silicon samples. On top of this film, two aluminum electrodes were also deposited. In between of the electrodes it can be seen a region of high carbon content left on the sample by other analysis technique.



Strengths na limitations of XPS Analysis

- Chemical state identification on surfaces
- Identification of all elements except fof H and He
- Quantitative analysis including chemical state differences between samples
- Applicable for a wide variety of materials, including insulating samples (paper, pastics and glass)

- Detection limits typically ~0.1 at%
- Limited specific organic information
- Sample compatibility with UHV environment

Ideal Uses for XPS Analysis

- Surface anslysis of organic and inorganic materials, stains or residues
- Determining composition and chemical state information from surfaces
- Depth profiling for thin film composition
- Thin film growth measurments

- Biomedical/biotechnology
- Photonics
- Polymer
- Semiconductor

Ideal Uses for Auger Analysis

- Defect analysis
- Particle analysis
- Small-area depth profiling
- Process Control
- Thin film composition analysis

- Biomedical
- Displays
- Electronics
- Semiconductors

Strengths na Limitations of Auger Analysis

- Small area analysis
- Excelent surface sensitivity
- Good depth resolution

- Standards required for best quantification
- Insulators are difficult
- Samples must be vacuum compatible
- Relatively poor detection sensitivity ~1 at%