Photoelectron Spectroscopy

Photoelectron spectroscopy utilizes photo-ionization and analysis of the kinetic energy distribution of the emitted photoelectrons to study the composition and electronic state of the surface region of a sample.

Traditionally, when the technique has been used for surface studies it has been subdivided according to the source of exciting radiation into :

X-ray Photoelectron Spectroscopy(XPS) - using soft x-rays (with a photon energy of 200-2000 eV) to examine core-levels.

Ultraviolet Photoelectron Spectroscopy (UPS) - using vacuum UV radiation (with a photon energy of 10-45 eV) to examine valence levels.

The development of synchrotron radiation sources has enabled high resolution studies to be carried out with radiation spanning a much wider and more complete energy range (5 - 5000+ eV) but such work remains a small minority of all photoelectron studies due to the expense, complexity and limited availability of such sources.

Physical Principles

Photoelectron spectroscopy is based upon a single photon in/electron out process and from many viewpoints this underlying process is a much simpler phenomenon than the Auger process.

The energy of a photon of all types of electromagnetic radiation is given by the Einstein relation :

$$E = h\nu$$

where h - Planck constant (6.62×10^{-34} J s)

ν - frequency (Hz) of the radiation

Photoelectron spectroscopy uses monochromatic sources of radiation (i.e. photons of fixed energy).

Que Write differences between AES and PES ?

	Auger Electron Spectroscopy	Photo Electron Spectroscopy
1	Auger Spectroscopy is a method used to determine the composition of the surface layers of a sample. There are three steps: 1) atom is ionized by removing a core electron from k-Shell, 2) upper level electron falls to lower level, 3) third electron (Auger electron) is excited by the energy given off in step 2 and detected The atom is left with two vacancies	Photoelectron spectroscopy utilizes photo ionization and analysis of the kinetic energy of the emitted photoelectrons to study the composition and electronic state of the surface region of a sample. In this process the outermost shell e- is ejected by a photon.
2.	A beam of high energy electron of energy 3-20keV are incident upon a sample.	Photoelectron spectroscopy uses monochromatic source of radiation which is either soft x-rays (with a photon energy of 200-2000 eV) Or UV radiation (with a photon energy of 10-45 eV)
3	Doubly ionised species is formed.	Singly ionised species is formed.
4	As overall two e- are ejected so two holes are created in the sample.	As overall one e- is ejected so one holes is created in the sample.
	1) Ionization of core electron 2) Upper level electron falls to a lower level releasing a quantum of energy 3) The energy released from the second electron excites the Auger electron which leaves the atom Auger electron detector	