



UNIT-5 XPS - Good for extra preps

Chemistry (SRM Institute of Science and Technology)

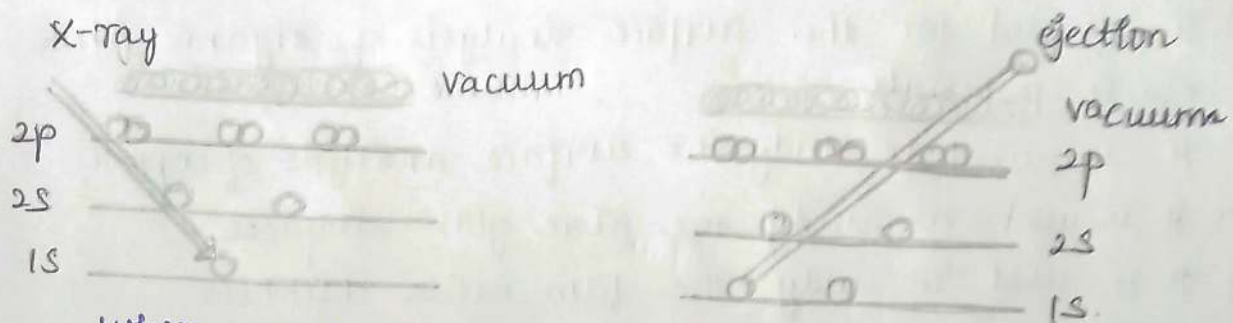


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X-RAY PHOTOELECTRON SPECTROSCOPY (XPS)

- XPS has developed by Kai Siegbahn in 1960
- It is a surface characterisation technique. It is used to find out the element present at the surface of the materials.
- It can analyse a sample to the depth of 2 to 5 nm
- XPS can also reveals the nature of chemical bond that exists between the elements.
- XPS can detect all elements except H_2 and He.

* PHOTO EMISSION PRINCIPLE:-



When an x-ray bombards a sample, some electrons become excited and escape to the surface of the atom. The ejected photo electrons in the vacuum are collected by an electron analyzer. The electron analyzer measures the kinetic energy of the ejected electrons.

The electron analyzer produces an energy spectrum of number of photo ejected electrons (vs) time in x-axis and binding energy (in y-axis). Binding energy is the energy the electrons had before leaving the atom. Each prominent energy peak on the spectrum corresponds to a specific element.

* Spectrum:-

- In the spectrum. There is a peak at 284.6 eV which corresponds to carbon and a peak at 532.5 eV

corresponds to oxygen. Therefore from the spectrum we know that the sample contains carbon and oxygen.

→ By applying relative sensitivity factors and approximately integrating peak areas, it can be determined that the sample contains 25% of oxygen and 75% Carbon.

→ By studying the energy of the carbon peak, it can also be determined if the surface of this material corresponds to C-O (single bond) or C=O (double bond).

* Applications:-

- (i) XPS is used for analyzing the surface chemistry of a material.
- (ii) It is used for the surface analysis of organic and inorganic materials.
- (iii) It is used to study the surface analysis of copper.
- (iv) It is used to study the fibre glass surfaces.
- (v) It is used to study the film oxide thickness measurements.
- (vi) It is an important analytical tool in wood adhesion research area.
- (vii) It is a unique approach in probing electronic structures.

* Instrumentation:-

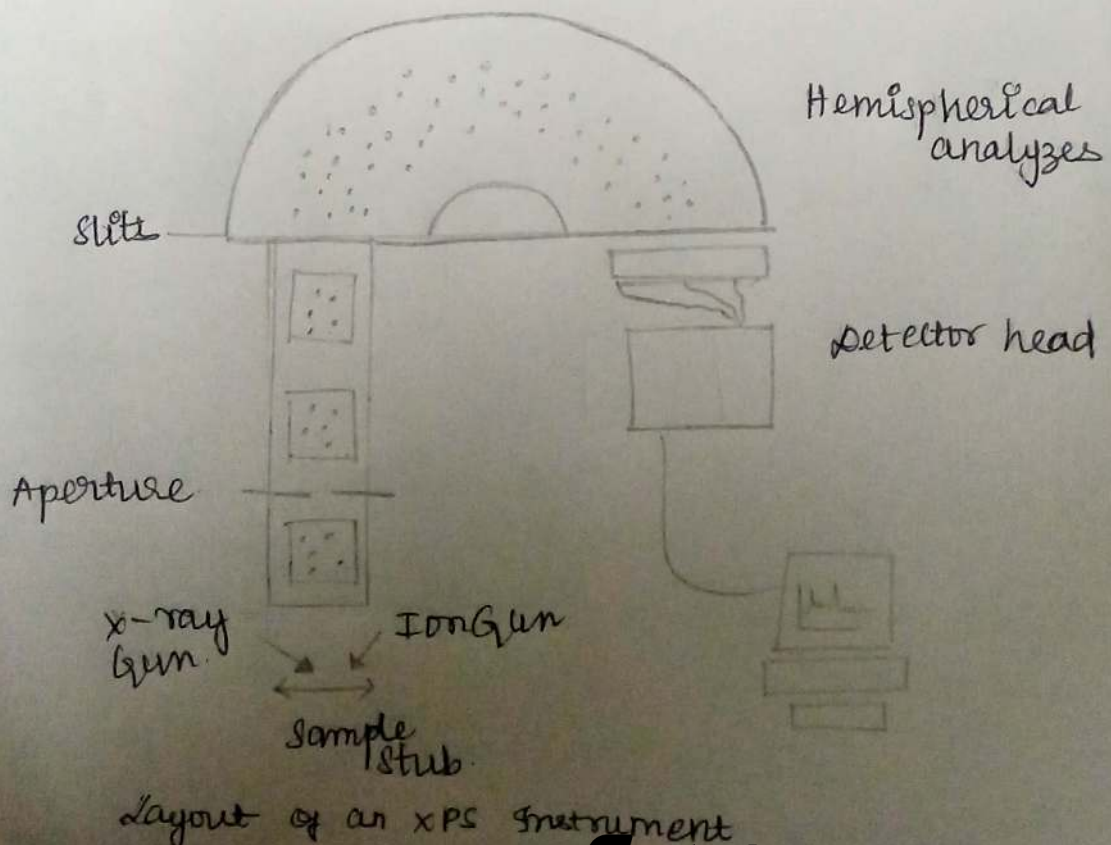
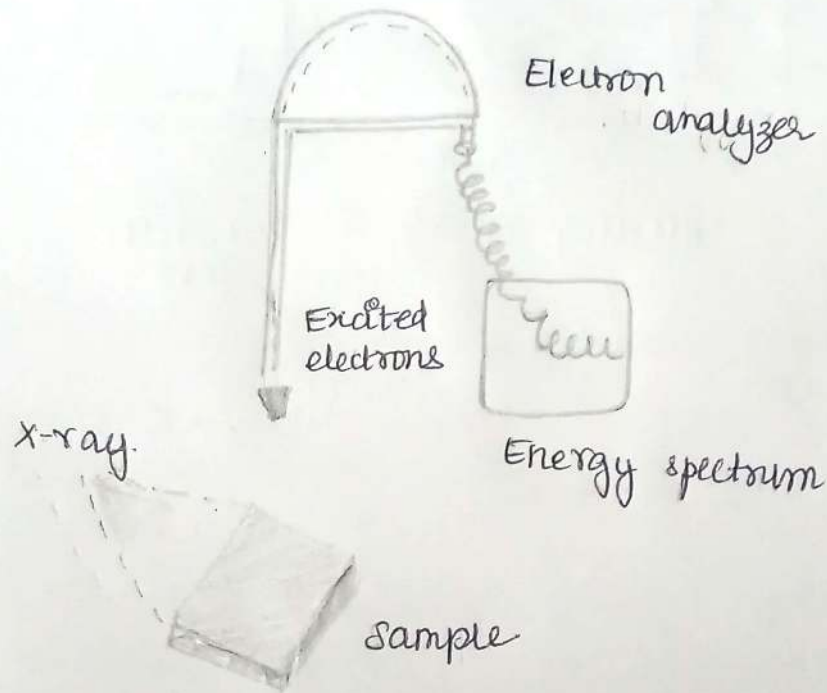
→ XPS is conducted in ultrahigh vacuum conditions, around 10^{-9} millibar.

1) When X-rays are illuminated through the sample under study, it causes the ejection of electrons having different range of energies and directions.

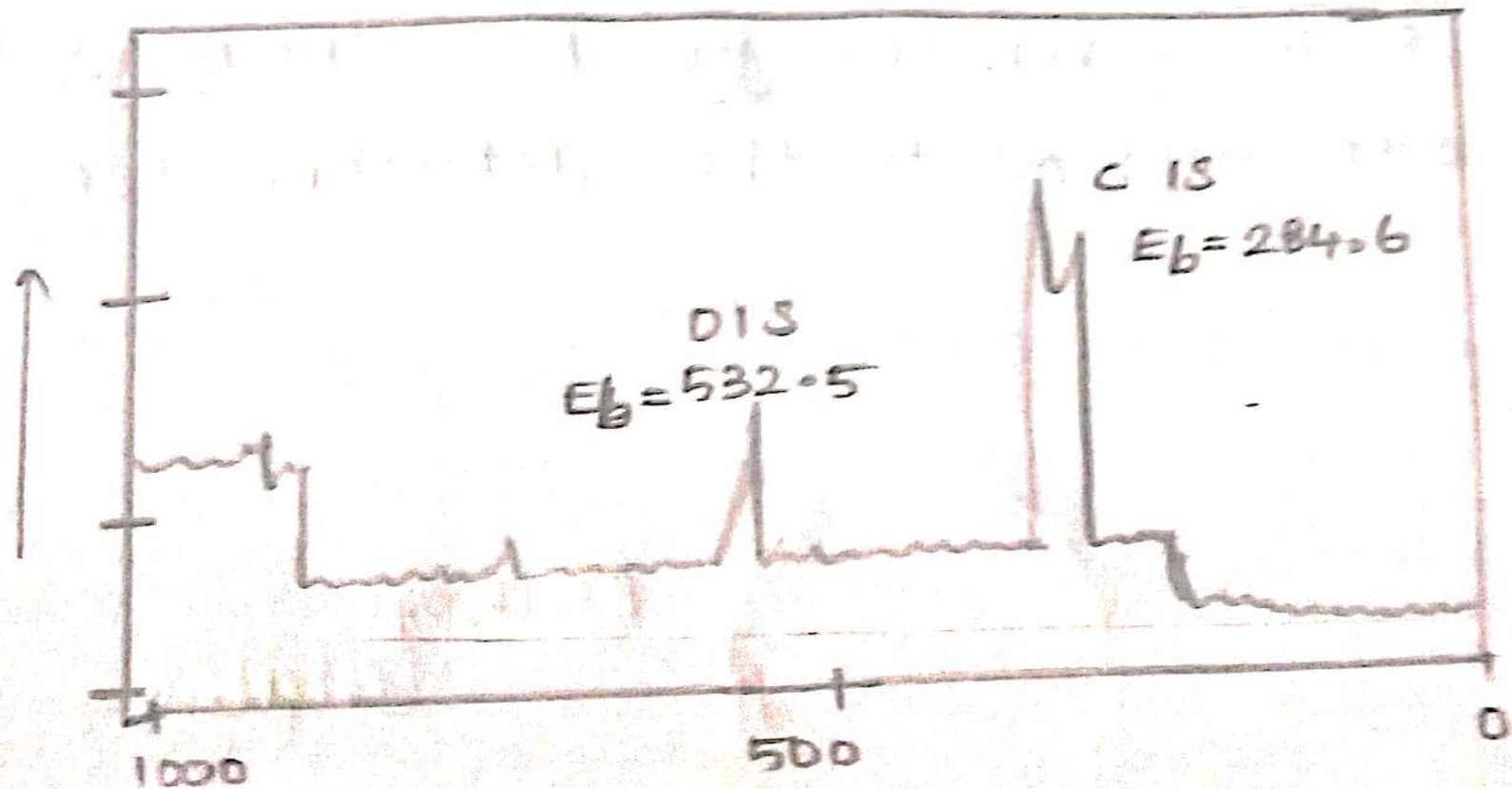
2) These emitted electrons are collected by a set of electrostatic and or magnetic lens units and transferred.

through the apertures and focused onto the analyzer entrance slit.

3) The electrostatic fields within the hemispherical analyzer allows electrons of a given energy (Pass Energy) to arrive at the detector slit and on to the detectors for recording.



Number of electrons



Binding energy in Electrovolt (eV)