# X-Ray Photoelectron Spectroscopy: An Emerging Tool to Understand the Electronic Structure of the Materials

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X-Ray Photoelectron Spectroscopy (XPS) or Electron Spectroscopy for Chemical Analysis (ESCA) has been widely used to determine the chemical state, bonding information, density of the electronic states, and the overall electronic structure of the materials. XPS is a non-destructive spectroscopic technique based on the photoelectric effect using soft X-rays to identify the surface elements and their applicability to various materials, from biological materials to metals. This tool can be versatile in studying the surface states of the materials and in-depth profiling (i.e., different depths of the materials) with ion-beam etching. In general, the sources of X-rays are eighter from Al Kα (1486.6 eV) or Mg Kα (1254.6 eV) anode radiation in high vacuum conditions for laboratory applications.

A typical work related to understanding the surface properties of ZnO nanoparticle-anchored carbon nanofiber (ZnO-CNF) hybrid thin film devices with depth is reported. The surface states of the films with various depth levels are measured using a K-Alpha XPS spectrometer, Thermo Scientific, USA. The source energy is Al Kα X-ray radiation (1486.6 eV), and the $Ar^+$ beam of energy 2 KeV @ etch rate of 0.31 nm/s for 900 s. Each element's survey scan (@ 200 eV pass energy and 1 eV step size) and core-level spectra (@ 50 eV pass energy and 0.1 eV step size) are recorded for every 60 s of etch time. All the measurements are performed at an analysis chamber pressure of $2.5 \times 10^{-9}$ mbar. The standard carbon C 1s binding energy (BE) of 284.8 eV is referred to as charge calibration of the spectra for all elements. The band-energy picture of CNF-p-ZnO interface is constructed with the XPS and work function measurements.

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**References**

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