



## Characterization of Nanostructured Materials by X-ray Photoelectron Spectroscopy

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There are several surface analysis techniques that employ the interaction of photons, electrons, ions, or atoms with the material surface. Here we concentrate on a technique that utilizes low energy electrons ( $E < 1.5$  keV) as probing particles. These electrons are adequate to the investigation of surfaces because their inelastic mean free path in solids corresponds only to few atomic layers (0.5 to 3.0 nm). Surface analysis techniques can make use of these low energy electrons in one of the following manner: (1) impinging electrons cause the emission of backscattered and secondary electrons and (2) electrons are excited by irradiated photons. The first case includes the emission of Auger electrons, while photoemission fits in the second case. X-ray photoelectron spectroscopy (XPS) is one of the most used surface analysis techniques due to its ability to not only identify the surface constituents but also their chemical states. Although XPS is employed widely in all fields of pure and applied sciences, we will only consider its use in materials science. The main emphasis will be on XPS excited by synchrotron radiation. Examples will be given in the characterization of ultra-thin films of transition and noble metals deposited on metallic single-crystal substrates, such as Pd on Ni(111), Ni on Pd(111), and Pd on Au(111).