Mean free path and effective attenuation length dependency with the photoelectron kinetic energy on Au: from 1 KeV to 15 KeV.

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X-ray photoelectron spectroscopy is a well-established technique in the low kinetic energy range. Its success is mainly based on the exhaustive knowledge of the photoelectron inelastic mean free path (IMFP) and effective attenuation length (EALs). The extension of XPS to higher electron kinetic energies allows the accessibility to buried interfaces and to the bulk due to the increase of the electron escape depth. Inelastic mean free paths are well established for electrons with kinetic energies up to several KeV (around 3 KeV). However, no data is available for kinetic energies up to 15 KeV. Even more, the theory applied to low energies could not be extended to higher kinetic energies due to the increase of the elastic events. Hence it is of primary importance to accurately determine the IMFP and the EALs for photoelectrons with kinetic energies for the HAXPES range.

The SpLine set-up offers an exceptional capability to measure simultaneously the diffracted signal (XRD) and the photoemitted spectra (HAXPES) of a determined substrate and evaporate (MBE) another material during measurement. Under such conditions we are able to determine the exact thickness of the deposited layer from the kiessig fringes and the MFP/EALs from the HAXPES signal. It is important to stress that due to the simultaneous detection of the diffracted and photoemitted signal, the MFP/EALs and thickness determination corresponds exactly to the same sample region. In the present study we have determined the MFP and EALs as a function of the energy (up to 15 KeV) for gold. For that, we have performed the evaporation of Au on a Cu substrate. By changing the thickness of the deposited Au layer we have followed the evolution of the Cu 1s, 2s and valence bands peaks in order to determine the MFP and EALs through the Au layer. Also, for a fixed Au layer thickness, we have followed the evolution of the Cu 1s and Au 2p, which normalized with the calibrated cross-sections (see another SpLine contribution at the same workshop), enables us the determination of the MFP and EALs dependency with the photoelectron kinetic energy. A compositional depth-profile analysis will be presented, which is based on the obtained EALs and cross-sections for high photoelectron kinetic energy. These results demonstrate the exceptional capability of the experimental setup installed at SpLine.