Electron Spectroscopy of Surfaces

Advanced Lab Course (FOPRA), Experiment Nr. 35, WS 2020/2021,
Physics Department E20, Room 229

This experiment focuses on photoelectron spectroscopy (PES), a widely employed technique that provides detailed insight into elemental composition, electronic structure and chemical state of a broad range of condensed matter systems and, in particular, of solid surfaces and ultra-thin films. The technique exploits the emission of electrons from the core levels of atoms upon irradiation of a sample with photons of well-defined energy, and is - therefore - intrinsically surface sensitive.

The aim of the experiment is to make the students familiar with the fundamental principles and applicability of the technique, the range of information that can be gained, and the basic instrumentation required. During the experimental session the students will perform measurements on a number of different samples, including pristine tungsten, a thin film of metallic magnesium deposited on tungsten, and an oxidized magnesium film. Based on the inspection of wide energy scans and on the line shape and energy position of individual core-level spectra acquired at different resolutions, elemental and chemical analysis of these systems will be possible, whereas by changing the electron collection geometry higher surface sensitivity can be achieved.

Physical Content

- X-ray photoelectron spectroscopy (XPS) and photon-induced Auger electron spectroscopy (AES). In particular: initial and final state effects in photoemission; Auger and fluorescence decays; chemical shifts; spin-orbit splitting; plasmon excitations.
- Basics of ultra-high vacuum technology (UHV).
- Adsorption at surfaces (physisorption und chemisorption), thermal desorption.

Experimental Set-up

X-ray tube for soft X-ray radiation, electron energy hemispherical analyzer, magnesium evaporator and gas-handling line mounted on a UHV chamber equipped with ion pump, titanium sublimation pump, and pressure gauge. An additional (tailor-made) load-lock chamber, pumped via a turbo-molecular pump can be used for the fast insertion of *ex-situ* prepared samples into the PES apparatus.

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