The SPELEEM at the Nanospectroscopy Beamline at Elettra: Present status and performance

S. Heun

TASC-INFM Laboratory, Area di Ricerca, Basovizza, 34012 Trieste (TS), Italy

The rapid progress of experimental techniques with access to chemical composition, electronic structure, magnetization, and fluctuations in these properties at submicron and mesoscopic scales has been fuelled by the demand imposed by the continuous miniaturization and increasing complexity of the materials used in modern technology. Advances in instrumentation, in particular improvement of the lateral and spectral resolution of photoemission and transmission x-ray microscopes, have been facilitated by the construction of the third generation synchrotron light sources in the last decade.

In my talk I will illustrate the potential of the spectroscopic photoemission and low energy electron microscope (SPELEEM) operating at the Nanospectroscopy Beamline at Elettra. The SPELEEM is a commercial LEEM system (Elmitec company) equipped with an imaging energy filter. The incorporation of a band pass energy filter has dual role. It allows us to select a narrow energy window for imaging, which reduces the chromatic aberrations and results in a gain of lateral resolution, and adds a second spectroscopy option, namely x-ray photoelectron spectroscopy (XPS). Using this spectroscopy option the SPELEEM instrument can be operated in different imaging modes, XPEEM (x-ray photoemission electron microscopy), PED (photoelectron diffraction), and small spot micro-XPS. An important advantage of the SPELEEM is the incorporated electron gun, which adds LEEM and micro-LEED techniques for obtaining structural information from the same sample area where XPEEM is performed. That makes the experimental station a real multi-technique spectromicroscopic probe.

The Nanospectroscopy Beamline was designed to provide the highest possible photon flux density in combination with moderate energy resolving power. Two APPLE II type undulators and monochromator provide high flux-density photon beam with variable polarization within a wide energy range (10-1000 eV). The maximum photon flux of 2×10^{13} ph/s is reached at about 145 eV. The beam is focused onto the sample by two bendable plane elliptical mirrors mounted in a Kirkpatrick-Baez configuration. A spot size of 25 µm x 2 µm (hor x vert) has been measured on the sample. Due to the grazing incidence (16º) of the photon beam onto the sample, the spot size in the plane normal to the beam is 7 µm x 2 µm.

The high brightness of the Elettra light source, together with an optimized microscope, results in a lateral resolution of 22 nm and an energy resolution of better than 200 meV in XPEEM mode.

At the end of the seminar some selected results from various fields of nano-material and surface science research will highlight the performance and the potential of this energy-filtered x-ray photoemission electron microscope.