Chemical imaging with the zone plate based photoemission microscope of Elettra: another step to bridge the Material Gap

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X-ray photoelectron spectroscopy (XPS) has remained the best method for probing the chemical and electronic structure of solid surfaces and interfaces. Using conventional X-ray tubes the yield of the photoelectrons emitted from the atomic electron levels is relatively low, which has imposed severe limitations on the spatial and energy resolution of the laboratory XPS machines. This major obstacle in development of the XPS microscopy has been overcome with the construction of the third generation synchrotron facilities. They provide ultra-bright, spatially coherent and tuneable photon beams, which is of fundamental importance to push the XPS lateral resolution into submicrometer length scales, maintaining a sufficient signal level and an acceptable acquisition time.

The scanning photoemission microscope (SPEM) available at the EscaMicroscopy beamline of the Elettra Synchrotron Light Source allows sample's chemical mapping with a spatial resolution below 100nm and the acquisition of photoemission spectra on regions with the same dimension by using zone plates (ZPs) as focusing elements. With respect to the photoemission spectromicroscopy techniques which require electromagnetic fields to achieve the spatial resolution, e.g. X-PEEM, the ZP-based SPEM is able to probe samples regardless their shape, structure and morphology. This property makes it an ideal tool for studying nanostructures often characterised by huge aspect ratios. Goal of this presentation is to provide an overview of the results and capabilities of the SPEM obtained in the field of nanoenergetics during its 16 years activity. Topics covered will focus on (i) chemical stability of materials used in the fabrication of solid oxide fuel cells (SOFCs) and proton exchange membrane fuel cells (PEMFCs) [1], (ii) characterization of single semiconducting nanostructure [2], (iii) experimental approached to bridge the material and pressure gaps for catalytic reaction investigations [3].

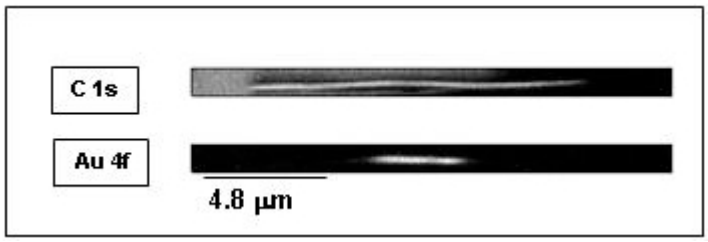

Fig.1: photoemission maps of a multiwall carbon nanotube with a confined Au patch recorded at the C 1s and Au 4f core levels.

[1] B. Bozzini et al. ChemSusChem 4 (8), 2011, 1099–1103.
[2] F. Jabeen et al. Nano Research 3 (10), 2010, 706-713.
[3] M. Dalmiglio et al. J. of Phys. Chem. C, 114 (40), 2010, 16885-16891