The zone plate based SPEM at Elettra: recent achievements and future projects in surface and interface studies

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Abstract:

A scanning photoemission microscope uses the most direct approach to obtain the spatial resolution i.e. the focalization of the incoming x-ray beam. The x-ray SPEM at the Elettra synchrotron light source located at Trieste, Italy [1] de-magnify the photon beam by means of a Fresnel zone plate. The photon energy range available (400-800 eV) covers the most intense core levels of the majority of the atomic species making the SPEM an ideal tool for the chemical characterization at the meso- and nanoscale. Recently, thanks to the improvement in the quality of the focusing optics, nanostructures as wide as 45 nm have been imaged and characterized. The overall energy resolution achievable in working conditions at RT is around 200 meV. In-situ samples can be heated, cooled and biased.

Investigation of the electronic, physical and chemical properties of nanostructures is one of the key topics of the research addressed by the SPEM. An overview of the most recent results obtained will be offered. It will include the following issues: (i) metal interfaces, gas interaction and mass transport on multiwall CNT by probing a single tube [2]; (ii) compositional and electronic studies of TCO nanostructures based on ITO, InN, SnO_2, etc. compounds [3,4]; (iii) chemical and electronic behavior of e-noses and nanosensors under working conditions [5]; (iv) size and surface chemistry effects on the conductivity of MBE-grown GaAs nanowires [6].

Finally an overview of the limits in the applications of the x-ray photoelectron microscopy imposed by the operation principles will be given together with the future developments allowing the investigation of materials at mbar and even ambient pressure.

References:

[1] http://www.elettra.trieste.it
[2] A. Barinov et al. Adv. Mater. Volume 21 Issue 19, 2009. DOI: 10.1002/adma.200990067.
[3] D. Maestre et al. J. Phys. Chem. C 2010, 114, 3411–3415.
[4] D. Maestre et al. J. of Nanosc. and Nanotech., Volume 9, Number 3, March 2009 , pp. 1772-1777(6).
[5] A. Kolmakov et al ACS Nano, 2008, 2 (10), pp 1993–2000.
[6] S. Rubini et al. article in preparation.

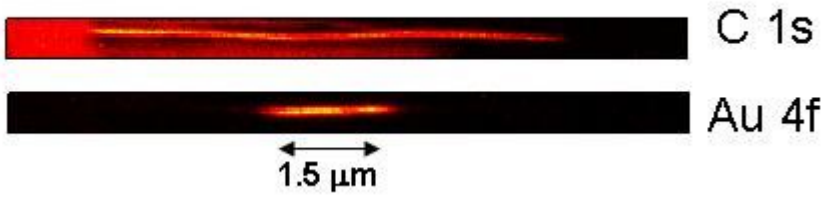

Figure 1: photoemission images of a single MWCNT grown on a Si substrate partially covered by a Au patch. The diameter of the MWCNT is approximately 90 nm. As clearly visible in the Au map the gold patch is about 1.5 μm long.