

Report on experiments MI667 and HE-1682

MI667 - VOLPE Project: VOLume Sensitive PhotoEmission from solids with Synchrotron Radiation (February 2004)

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The VOLPE set-up was assembled at ESRF in January 2004 and installed in February 2004 on beamline ID16 for first experiments, MI667 (main proposer Dr. G. Paolicelli, INFM Univ. Rome III). Main results

- a) Negligible surface contribution, as revealed from the intensity measured on d and s band of Ag, without any cleaning of the sample (neither scraping nor sputtering) over 48 hours, in a 10^{-7} mbar vacuum.
- b) Bulk sensitivity at about 5 keV and 7 keV kinetic energy, measuring 2p core level emission from Co buried under a capping layer of 75 Å and 120 Å thick. (Fig.1).

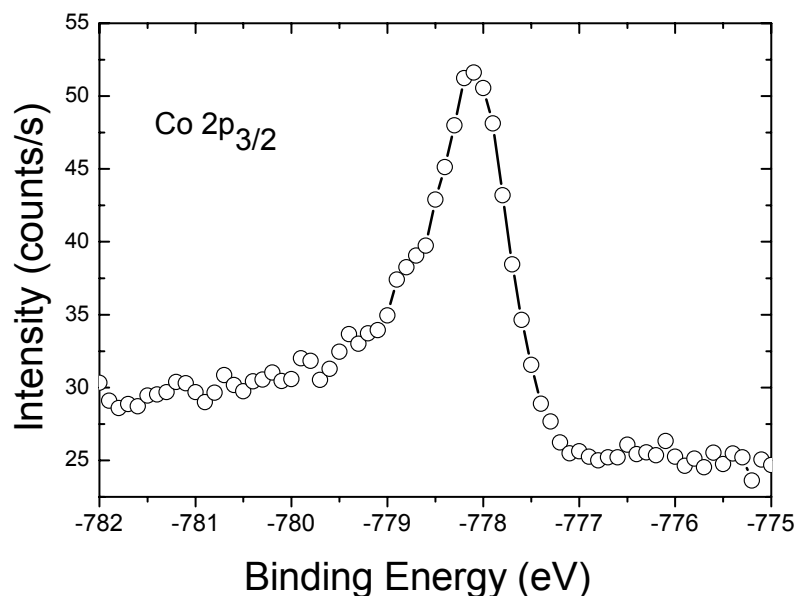


Fig. 1 Co 2p 3/2 core level measured at $h\nu = 5934$ eV. Blue: Co signal under 7.5 nm of Ta/MnIr capping.

- c) An overall energy resolution (photons+analyser) of 120 meV, measured on Fermi level of polycrystalline Ag (Fig.2)

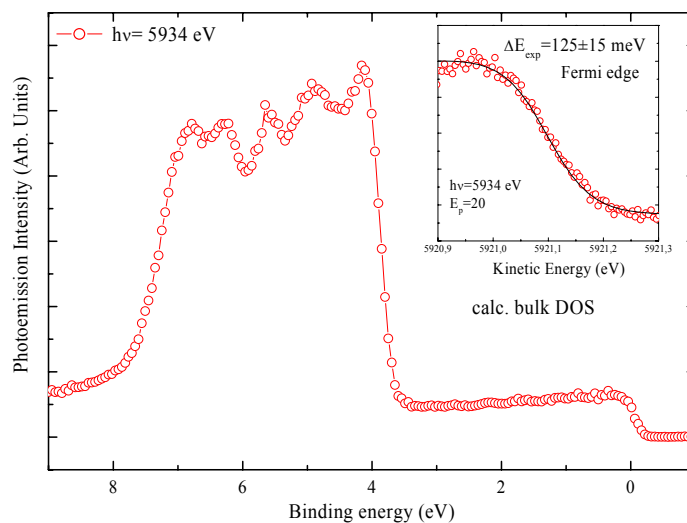
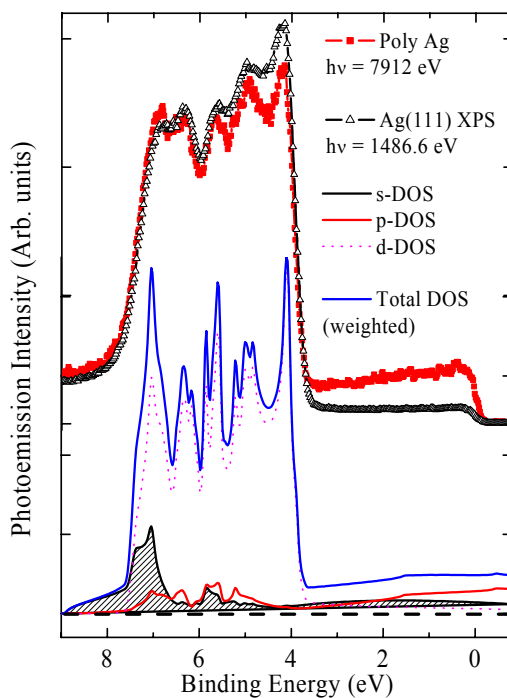


Fig. 2 Ag Valence band and Fermi level as measured at $h\nu = 5934$ eV



In collaboration with N.Stojic (ICTP, Italy) we performed a detailed comparison between bulk sensitive experiment and calculation. Figure 3 shows the bulk sensitive spectrum of polycrystalline silver measured at 7912 eV, compared to the XPS one (1486.6 eV); the enhanced contribution of the sp states when approaching the Fermi level is clear. Moreover, we found an excellent agreement between experiment and calculation, where the position of the hybridized s-states (shaded black area) has been accurately determined.

HE1682 - High Energy Valence Band Photoemission on highly correlated systems (June 2004)

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Main results:

- a) Improved overall energy resolution, i.e. 71 meV at 5934 eV as measured on the Fermi level of polycrystalline Au, corresponding to 50 meV energy resolution of the spectrometer. (Fig.1).

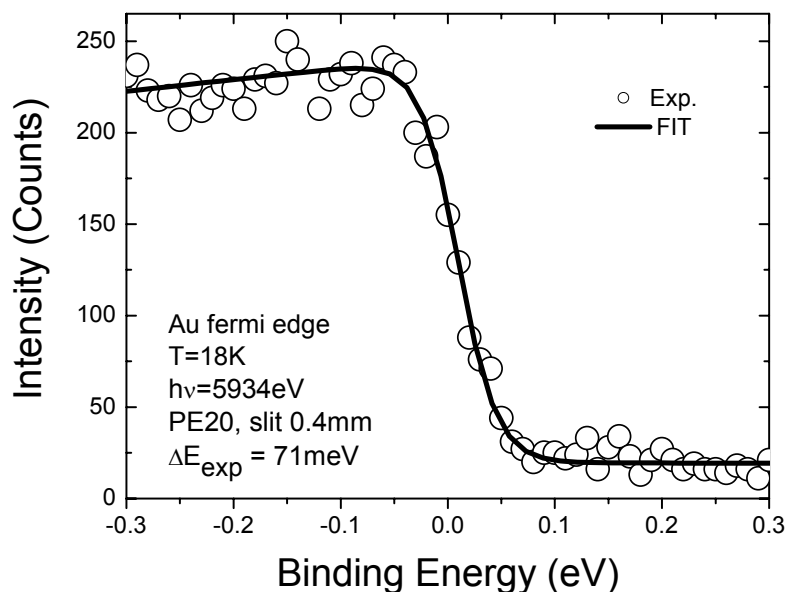


Fig. 2 Ag Valence band and Fermi level as measured at $h\nu = 5934$ eV

- b) Bulk sensitivity at least 3 times better than XPS measurements performed with K_{α} radiation (1486.6 eV), usually considered quite bulk sensitive together with a negligible surface contribution.
- c) Sizeable valence band signals (including the clear measure of the opening of gap when crossing the Mott Insulator transition) measured at 5934 eV of kinetic energy on 3d band of complex oxides (Fe_3O_4 and V_2O_3), where the estimated cross section is 10^{-6} MBarn (to be compared with $10^{-1}, 10^{-2}$ at lower kinetic energies) (Fig.3)

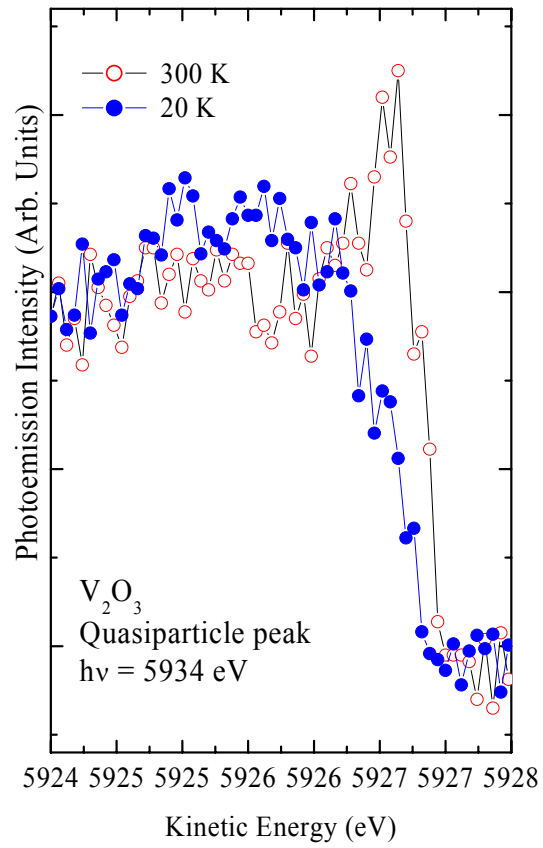


Fig. 2 Temperature dependence of the PES spectra in the region near the Fermi level from V_2O_3 , as measured at $h\nu = 5934$ eV. The quasiparticle peak at 300 K disappears after crossing the Metal-Insulator Transition and a gap opens.