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Combining atomic spatial resolution with X-ray absorption spectroscopy at ALBA: connection of a scanning tunneling microscope to the BOREAS beamline.

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The study of supported adatoms, films or more complex nanostructures by X-ray absorption and circular magnetic dichroism (XMCD) requires their in-situ growth in ultra-high vacuum (UHV), and hence must be followed by some means of structural characterization that can be correlated to the spectroscopic data. Scanning tunneling microscopy (STM) provides structural information of surfaces with ultimate atomic resolution. Here we present a combined STM-XMCD study at ALBA, which has been realized by coupling a variable temperature STM of ICN2 to the BOREAS beamline via an ultra-high vacuum (UHV) transfer system.

We used this multitechnique set-up for the first time to study the magnetic and orbital moment anisotropy of 3d metal adatoms and few-atom clusters deposited on heavy-metal surface alloys. By depositing 1/3 of a monolayer of heavy metal (Bi, Sb) on a Ag(111) single crystal, ordered surface alloys with a record ($BiAg_2$) and negligible ($SbAg_2$) spin-orbit interaction were grown. The $\sqrt{3}$ x $\sqrt{3}$ R30° structure of the surface alloy was atomically resolved by STM, which allowed us to minimize the density of defects and obtain high quality, large domain surface alloys. After the surface characterization, Fe was deposited at room temperature, and the coverage-dependent size distribution of Fe nanoclusters was studied by STM (Fig. 1a). The samples were then successfully transferred in UHV to the HECTOR end-station for the XMCD measurements (Fig. 1b).

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Caption (s) - Add figures as attached files (2 fig. max)

Fig. 1: a) Atomically-resolved STM image of Fe adatoms, dimers and trimers deposited on the BiAg2 surface alloy. b) XAS spectra at the Fe L edge obtained with circularly polarized light (red/blue) and corresponding XMCD spectra (black), measured at the same sample.

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