



Experiment title:
Induced spin polarization in permalloy-Cu multilayers
by X-MCD on L_{2,3} edges

Experiment
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HC-265

Beamline:
26

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Local contact(s):
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Report:

We have performed at ESRF dichroic measurements on the BL26 (“Circular Polarization”) at the L_{2,3} edges of the 3 elements Ni, Fe and Cu in Ni₈Fe₂(15 Å)/Cu multilayer elaborated by molecular beam epitaxy and characterized at the laboratory by glancing angle reflectivity and Kerr effect. The Cu layer thickness was about 1, 2 and 3 atomic layers. The dichroic signal was measured in photocurrent mode, with systematic change between each energy scan either of the polarization helicity (Helios I undulator) or of the cryomagnet field (± 1 T); here only one beam was available. Only the results on the Cu edges results will be presented in the following.

The data treatment was as follows : from a family of spectra, one was used as a reference; then each other spectrum was multiplied by the smoothed ratio of its background to the background of the reference spectrum. In addition, possible energy shifts between individual spectra as well as minute changes of the energy spacing between the L₂ and L₃ edges were carefully taken into account; the resulting data, now all calibrated and on a flat background, were finally summed for better statistics.

The results for the three Cu layers (both XAS and XMCD) are shown on fig. 1.

An interesting feature is the presence of a small but real dichroic peak on top of the second peak of the absorption spectrum, at ≈ 938 eV. The dichroic intensity decreases regularly as a function of the number of Cu monolayer and shows :

- the existence of a Cu induced moment of d character, of the same sign as the Ni one
- the presence, in contrast with the case of the Co/Cu system [1], of a significant orbital contribution ; indeed, the use of the sum rules leads to a ratio of orbital to spin magnetic moments for the Cu d electrons :

$$\begin{aligned}
 M_L/M_S &= 0.14 * 0.01 && (1 \text{ ML}) \\
 &0.21 \pm 0.02 && (2 \text{ ML}) \\
 &0.38 \pm 0.04 && (3 \text{ ML})
 \end{aligned}$$

In spite of the uncertainty on the individual values for the spin and orbital moments (number of Ni 3d holes and transferability, background subtraction), these values are clearly smaller than in ref. [1].

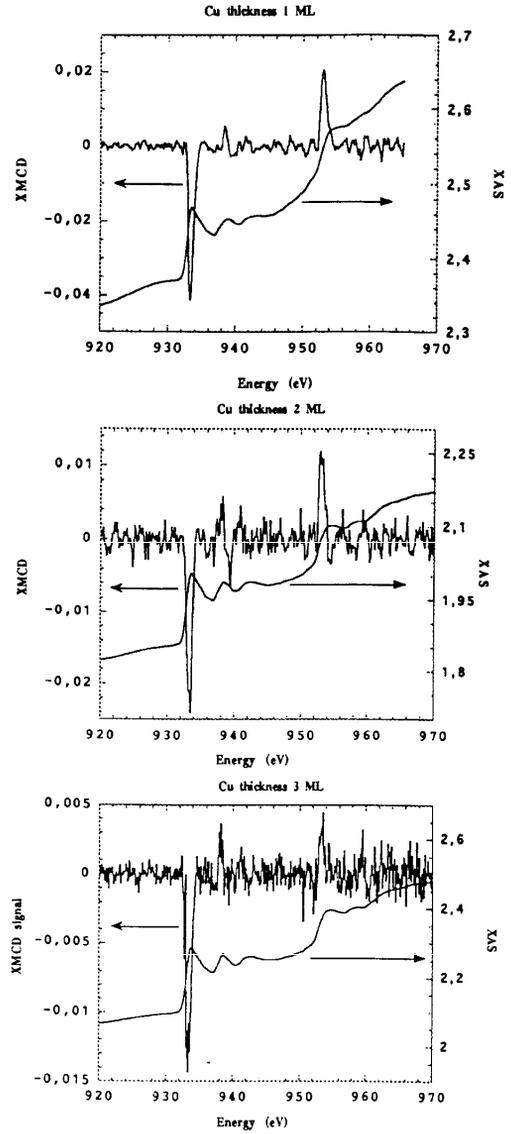


Fig. 1 Dichroic (XMCD) and absorption (XAS) spectra at the Cu L_{2,3} edges for 1-3 monolayers

In conclusion, these measurements show that ESRF allows very fine dichroic experiments : the signal is in the range of a few 10⁻⁵ and comes from only 1-2 near surface atomic layers and from very weak induced moments (a few 10⁻² μB for the spin, a few 10⁻³ μB for the orbit). Work is in progress for the interpretation of these results.

[1] M.G Samant et al, Phys. Rev. Letters 72 (1994) 1112