	Experiment title: Structural characterization of the FeF_2(110) surface and its influence on magnetic exchange bias phenomenon	**Experiment number**: 25-02-678
Beamline: BM25B	**Date of experiment**: from: 22/11/2009 to: 01/12/2009	**Date of report**: 31/08/2010
Shifts: 24	**Local contact(s)**: Juan Rubio Zuazo	*Received at ESRF:*

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Report:

The main goal of this proposal was to gain insight on the structural details playing a significant role on the magnetic exchange bias phenomenon. The system studied consisted in Co/FeF_2 bilayers *in situ* deposited by electron beam evaporation on top of MgF_2(110) single crystal substrates. The atomic structure of the system was characterized by doing surface x-ray diffraction measurements using the UHV chamber mounted on the 2+3 diffractometer available at beamline BM25B.

During the experiment, several efforts were devoted to find the optimum FeF_2 evaporation conditions. After optimizing these conditions, two differente bilayers could be prepared on top of two different MgF_2 (110) substrates. The corresponding reflectivity curves are shown in Figure 1. For the case of the thicker sample 1, the substrate preparation included ion bombardment + annealing + O_2 treatment. In the case of the thinner sample 2, ion bombardment was not applied, and just annealing and O_2 treatment were used. The growth of FeF_2 was verified by checking the changes in radial scans around several privileged directions of reciprocal space. Figure 2(a) shows one of these scans, around the K-direction, confirming the presence of peaks asociated with FeF_2 growth. The epitaxial character of the film was demonstrated by long azimuthal phi-scans with the presence of equivalent peaks at the expected 180º periodicity, as shown in Figure 2(b). Additional deposition of ferromagnetic Co films was confirmed by the changes in reflectivity curves (see Figure 1) and in H-scans, as those shown in Figure 3.

In spite of the good quality of the in-plane epitaxy, the out-of-plane measurements, consisting in the search of surface peaks at different places of reciprocal space, and in the recording of complete CTRs, (0 1 L), (0 2 L), (1 1 L) and (3 1 L), both of substrate and of FeF_2 films, had not enough signal to complete a detailed analysis of the structure. This means that further efforts are needed in order to improve the substrate surface preparation method, possibly including the use of chemical treatments. In any case, the magnetic characterization of the two sampes prepared is currently under way trying to find some correlations between the magnetic behaviour and the structural characterization carried out.

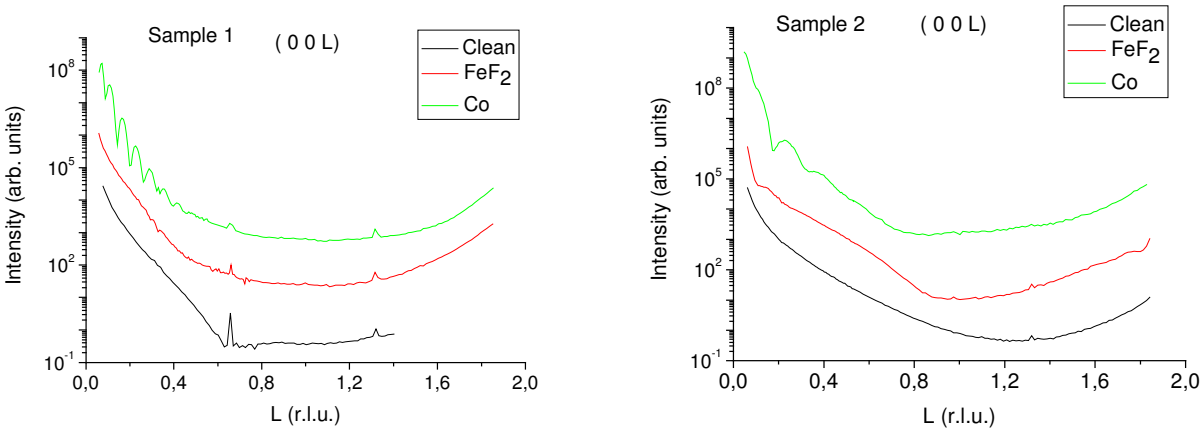

Figure 1. (0 0 L) reflectivity curves, vertically shifted for clarity, of the two $Co/FeF_2/MgF_2(110)$ bilayers prepared during the experiment ad different steps of the growth.

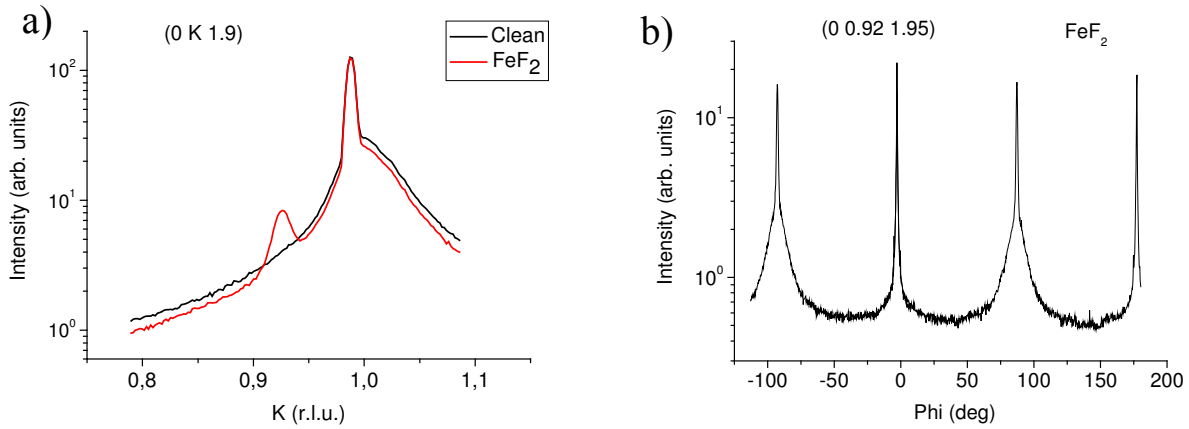

Figure 2. (a) Radial K-scan at L = 1.9 r.l.u. before and after deposition of a FeF_2 film. (b) Corresponding azimuthal long scan at the slightly higher value of L = 1.95 r.l.u.. The epitaxial growth of the film with respect to the substrate is demonstrated.

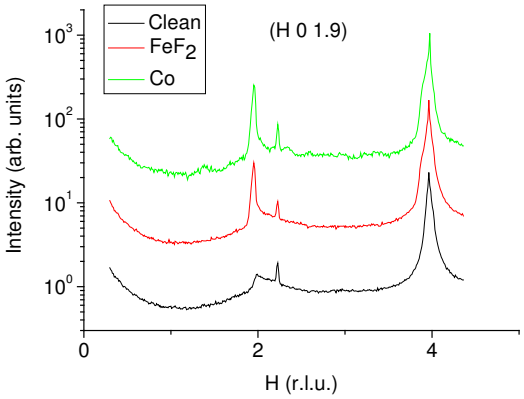

Figure 3. H-scans at L = 1.9 r.l.u. at different steps of the growth of the $Co/FeF_2/MgF_2(110)$ bilayer.