ESRF	**Experiment title:** X-Ray Magnetic Circular Dichroism Studies of Magnetic Layers from Modulated Specular Reflectivity measurements	**Experiment number:** HE-20,HE-126
Beamline: ID12A	Date of experiment: 4/12/96-7/12/96; 23./4/97-26/4/97, 18/6/97-21/6/97	**Date of report:** 13/8/97
Shifts:	**Local contact(s):** C. Neumann; J. Goulon	*Received at ESRF:* 22 AOUT 1997

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Report:

Motivation of specular reflectivity experiments:

XMCD is now a rather well established technique to probe local magnetic properties of ferromagnetic, ferrimagnetic or paramagnetic materials. Until recently, experimental difficulties hampered detailed XMCD studies dealing with{ 3d,4d}-materials. In the case of the L-edges, with a Si [111] or Ge[111]-monochromator the Bragg-angle is approaching 45” and the circular polarisation rate of the monochromatic x-ray beam becomes very poor eventhough the polarisation rate of the x-ray source is very high. For this reason we inserted the sample before the monochromator and performed differential specular reflectivity measurements in order to become completely independent of the polarisation transfer of the monochromator. A ‘miniaturised’ double-bounce-reflectometer has been developed and commissioned. It is based on two independent mechanics which allows the very precise alignment of the mirrors. A magnetic circuit consisting of a soft iron core and a copper coil makes it possible to magnetise the surface layer parallel to the beam direction and to flip the orientation of the magnetisation at a frequency of 1 Hz.

Results:

Two mirrors made out of a thick Silicon wafer have been produced. The first mirror was coated with a single Cobalt layer and the second one with a thin film of $Fe_{67}Rh_{33}$ magnetic alloy. The magnetic mirror was characterised by magneto-optical Kerr-effect measurements which confirmed the functionality of the magnetic circuit. We have performed differential X-ray Magnetic Reflectivity (XMR) spectra recorded respectively at the $L_{2,3}$-edges of Rhodium for several angles of incidence. All spectra were measured at room temperature while we kept the helicity of the x-ray photons fixed and simply reverted the direction of the magnetisation four times for each data point of an energy scan. The spectra were strictly reverted by reverting the phase of the helical undulator in order to switch to the opposite photon helicity.

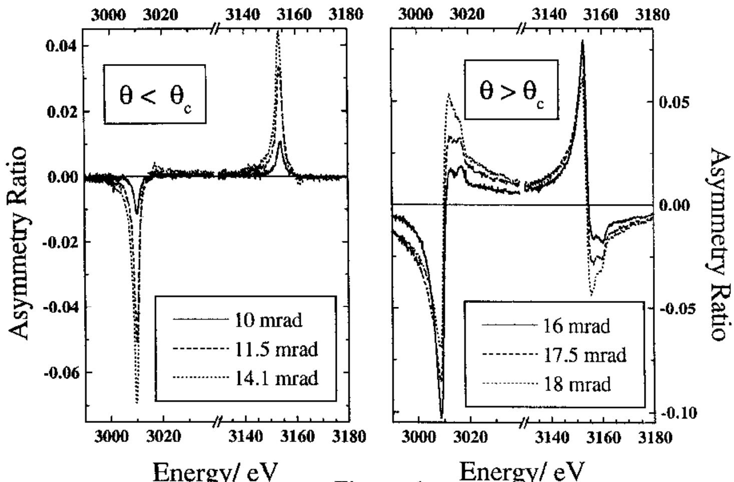

Figure 1

In figure 1 we plotted the asymmetry ratio averaged over 4 consecutive scans and it appears immediately that the asymmetry ratio has opposite sign at the L_2 and L_3 edges, in full agreement with the XMCD sum rules. In addition there are quite dramatic changes in the intensity of the signal and in the measured lineshapes when the angle of incidence is changed. What adds considerable involvement to the analysis of magnetic reflectivity experiments is the fact that the reflectivity depends inherently on both the real and on the imaginary part of the complex refractive index. In addition, by differential reflectivity calculations, one can easily show that, at the critical angle of incidence, the XMR-spectra will be fully dominated by the dispersive part In other terms, XMR-spectra recorded at the critical angle of incidence should be more or less equivalent to Faraday-rotation spectra recorded in the same energy range.

Publication:

C. Neumann, A. Rogalev, J. Goulon, M. Lingham, E. Ziegler (1997), to be published in Journal of Synchrotron Radiation (SRI'97 proceedings)