ESRF	Fe in-plane magnetisation profile and domain structure in ordered FePd alloy films with diffuse x-ray resonant scattering	**number:** HE-549
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Report:

FePd thin films can be grown in varying degrees of chemical order, where more ordered films show a strong perpendicular magnetocrystalline anisotropy. [1] In moderately ordered samples, the competition between PMA and shape anisotropy can lead to striped domains with a magnetisation profile ↑↓↑↓↑ in the film. This magnetic structure is characterised by magnetic flux lines partially outside the sample. Under these conditions internal flux line closure should occur, with closure domains at the sample surface. [2] This would represent a chiral domain pattern ↑→↓←↑→↓←. These closure domains cannot be observed with conventional magnetic imaging techniques which rely on the observation of stray fields outside the sample.

With resonant magnetic scattering it is possible to study the domain structure in greater detail. These experiments were carried out on beamline ID12 B, using a Daresbury two-circle diffractometer. When the x-rays are tuned to the Fe $L_{2,3}$ absorption edge, the large resonant enhancement of the scattering amplitude combined with the circular dichroism leads to a strong magnetic contribution in the scattering signal. [3]

Figure 1 shows diffraction scans taken in two different geometries. In geometry A the striped domains are perpendicular to the scattering plane. The scan is obtained by rocking the sample while keeping the detector (a photodiode) at a fixed scattering angle. The scan shows first-order magnetic satellites on either side of the central specular peak. The domain size obtained from the magnetic satellite positions agrees well with the domain perodicity found with MFM (910 Å). In this geometry no dichroism and no second-order magnetic peaks can be observed.

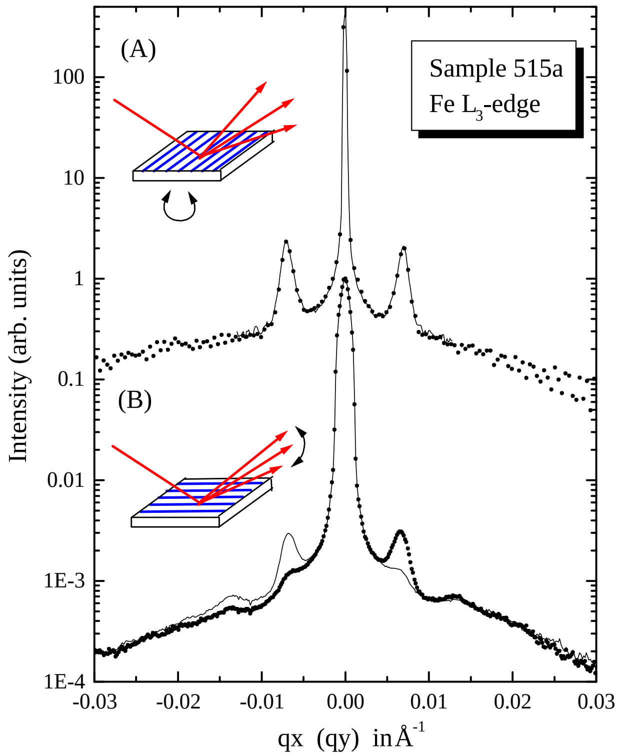

Fig. 1: Magnetic satellite peaks as observed in scattering geometries A (top) and B (bottom), with circularly polarised light (dotted line: left circularly polarised, solid line: right circ. pol.). The x-ray circular dichroism is only observable in geometry B.

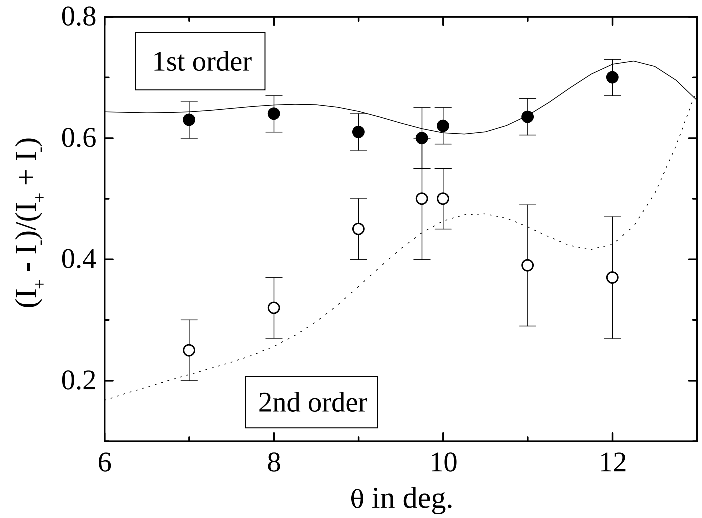

Fig. 2: Asymmetry ratio $(I_+ - I_-)/(I_+ + I_-)$ of the dichroism signal plotted against angle of incidence, θ. This information can be used to obtain a perpendicular magnetic profile of the sample. Dotted and solid lines are fits to a theoretical model.

In geometry B the stripes are parallel to the incident beam; the detector is mounted on a motorised arm which can be scanned perpendicularly to the scattering plane. First and second-order magnetic satellite peaks are visible, and the diffraction scans taken with left and right circular polarised light show clearly dichroism which changes sign across the specular peak. This dichroism is a result of the interaction of the circularly polarised light with the atoms in the chiral magnetic domain pattern, where the phase information – usually lost in diffraction experiments with linear polarization – is retained. [4]

Figure 2 shows the asymmetry ratio $(I_+ - I_-)/(I_+ + I_-)$ in the dichroism versus angle of incidence θ. It was found to vary considerably between $\theta = 5°$ and $\theta = 28°$ for first and second order satellites. This information can be used to model the perpendicular magnetic profile of the sample, and to find the effective depth of the closure domains (see reference [4] for more details).

References

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