ESRF	**Experiment title:** Magnetic domains in FePd films probed by soft x-ray resonant magnetic scattering	**Experiment number:** HE-426
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Report:

The easy direction of magnetization of ultrathin films is often determined by a competition of a perpendicular magneto-crystalline anisotropy (PMA) and an in-plane shape anisotropy. PMA is usually dominated by electronic hybridization at interfaces. Chemically ordered FePd ultrathin films for instance display a strong PMA due to their layered structure that consist of alternating Fe and Pd layers. The influence of film thickness, i.e. the number of Fe/Pd interfaces in the film, and its chemical order on PMA lead to a large variety of magnetic domain structures. [1] When the PMA is strong enough to overcome the shape anisotropy the system can reduce magnetostatic energy by forming spin-up and down domains. It was already shown more than 50 years ago that this leads to regularly spaced magnetic stripe domains. [2]

We probed the stripe domain structure by x-ray resonant magnetic scattering (XRMS) at the Fe L_3 absorption edge. The resonant scattering amplitude for electrical dipole transitions consists of three terms: the first one is caused be the Fe charge scattering and is responsible for the specularly reflected peak in Fig. 1; the other terms are magnetic scattering contributions that are linear and quadratic in the magnetization direction in the sample. This results in purely magnetic first and second-order magnetic satellite peaks located symmetrically around the specular reflection. Such magnetic satellites have been observed in the hard x-ray range. [3] Fig. 1 shows the first application of this technique to magnetic domain structures in the soft x-ray region where the photon wavelength matches the domain periodicity.

Since the photon beam is insensitive to any applied magnetic field, **H**, we can ideally study the field dependence of the domain periodicity with XRMS. The results are shown in the inset of Fig. 1. As the magnetic field is increased the satellite intensity is reduced and the peaks disappear completely above **H** = ±0.4 T. This can be explained by a reduction of the out-of-plane spin component with increasing field which reduces the PMA until it can no longer overcome the shape anisotropy and the stripe domain pattern disappears. Interestingly the domain periodicity remains almost unchanged as the field is increased. However, when the stripe pattern reappears after **H** is reduced from 0.5 T it shows a clearly smaller period. The periodicity goes back to the initial value as 0 T is approached. These results demonstrate the importance of the interplay of domain wall formation with PMA and shape anisotropy. A detailed modeling should allow to describe the energetics of the spin-reorientation transition.

References

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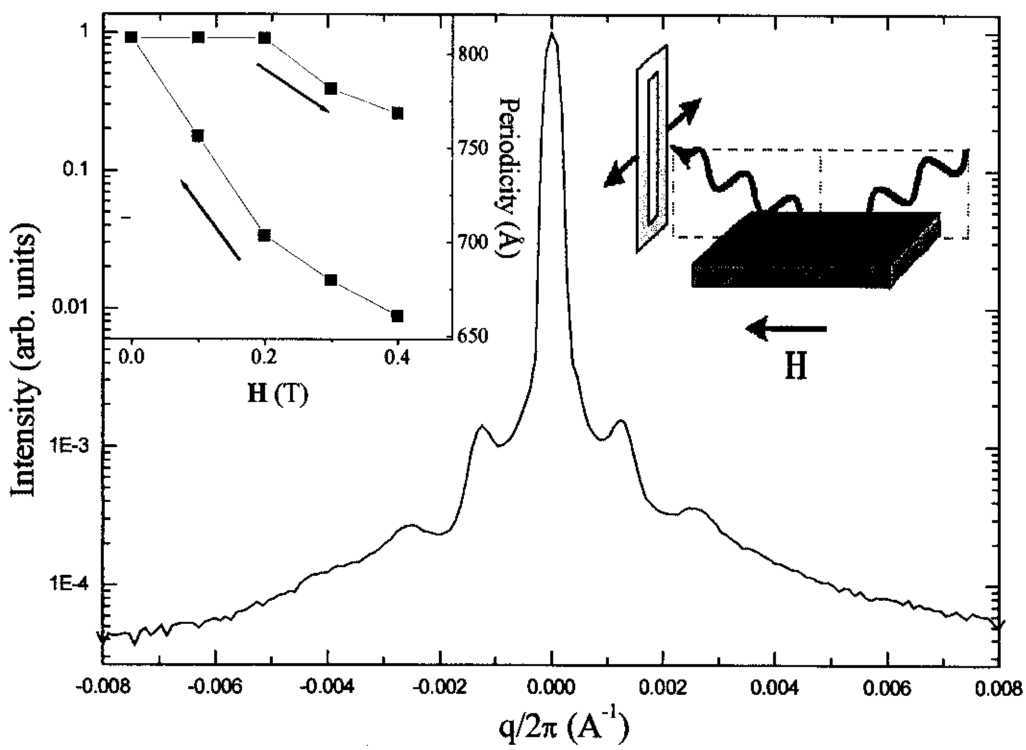

Figure 1. Scattered x-ray intensity versus wavevector transferred perpendicular to the stripe domains. The experimental setup is indicated in the inset. Scattered x-rays were detected by a photodiode mounted behind a rectangular aperture that could be translated along the sample surface. From the spacing of the magnetic satellite peaks the stripe domain periodicity was obtained. It is shown versus applied field in the inset.