

Studying Magnetization Reversal with X-Ray Magnetic Resonant Scattering

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Introduction: There has been a great deal of interest in developing experimental methods to investigate the domain structure and dynamics of thin magnetic films, especially since such films are integral components of high-technology devices. [1] Many of the existing methods, e.g., MOKE, probe the magnetic structure of the bulk material and do not readily resolve contributions from different atomic species in the material. To fully understand the magnetic structure of a complex material, one needs to be able to deconvolute these element-specific contributions to the magnetic and electronic structures.

Methods and Materials: Soft x-ray resonant magnetic scattering (SXRMS) is a technique that is element-specific and provides information about the average magnetic domain size. In a diffuse scattering geometry, one can extract this average domain size from the width of the diffuse part of the spectrum. Additionally, if the incident energy is tuned to an absorption edge that exhibits magnetic circular dichroism, element-specific hysteresis loops can be obtained. In this study, we measured the diffuse scattering as a function of applied field, hoping to obtain information regarding the size of the magnetic domains that flip at a particular value of the applied field. We applied this procedure to a CoFe thin film that was deposited on a thick copper underlayer that artificially roughened the film.

Results: There is a clear difference in the diffuse scattering as a function of the applied field as we progress around a hysteretic-type loop. With an appropriate extraction of the scattering parameters from the diffuse scattering spectra, an estimate of the magnetic domain size with the applied field can be made.

Conclusions: Distinctly different diffuse spectra taken at different applied fields demonstrate the utility of SXRMS to extract useful magnetic information regarding technologically important magnetic thin-films.

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References:

[1] S. P. Li, A. Samad, W. S. Lew, Y. B. Xu and J. A. C. Bland, *Phys. Rev. B* **61** (10) 6871 (2000-II).

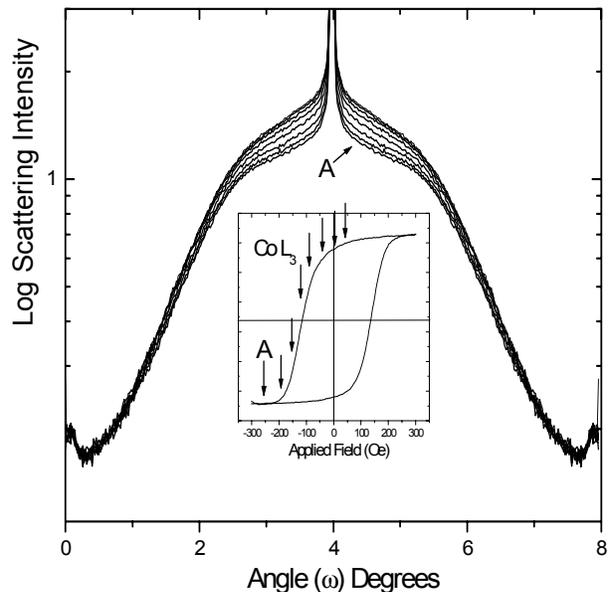


Figure 1. Diffuse scattering from a CoFe film as a function of applied field. The inset is the Co white line (L_3) intensity of the artificially roughened CoFe film as a function of applied magnetic field. The A in the inset corresponds to the field value at which the A diffuse spectrum was measured (the rest of the spectra correspond in order of the inset arrows).