Modulating the X-ray Polarization at a bending magnet for magnetic full-field soft X-ray transmission microscopy

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Full field soft X-ray transmission microscopy is a powerful tool to image at high spatial resolution and with element specific magnetic contrast magnetic microstructures in low dimensional magnetic systems that are currently discussed both for fundamental and applied studies. Circularly polarized x-rays are required for magnetic X-ray microscopy since x-ray magnetic circular dichroism(XMCD), i.e., the dependence of the photoabsorption cross section at element-specific binding energies on the relative orientation between photon spin and magnetic moments serves as the magnetic contrast mechanism [1, 2]

To control the circular degree of helicity at the full-field soft X-ray microscopy beamline XM-1 (BL 6.1.2) at the Advanced Light Source in Berkeley CA we have integrated a vertical adjustable slit aperture with variable width. Thus we are able to modulate either the right or left elliptically polarized X-rays emitted from the bending magnet. We demonstrated that the magnetic contrast of the magnetic domain structure recorded at the Fe L_3 edge in a 60nm amorphous $Gd_{25}Fe_{75}$ thin film can be modulated by the X-ray helicity modulation and it scales with the degree of circular helicity in agreement with theoretical calculations. This technique enables us to significantly reduce non-magnetic background contributions and to enhance magnetic contrast by comparing two images taken with opposite spin of the x-rays. It also opens a new avenue for lock-in recording schemes that might be advantegous for imaging fast magnetization dynamics with high resolution magnetic soft X-ray transmission microscopy.

[1] P. Fischer et al. Z. F. Physik (1996)

[2] P. Fischer et al. (2005) this volume