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Angle-dependent x-ray magnetic linear dichroism at Fe and Ni L edges

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The detailed knowledge of the spin arrangements in engineered magnetic nanostructures comprised of multiple magnetic species is essential to tailor their properties for device applications e.g. in information storage technology. Soft x-ray magnetic dichroism spectroscopies play a very important role in improving our understanding of complex heteromagnetic nanostructures since they provide elemental and chemical site-specific magnetic information with high sensitivity and tunable probing depth. X-ray spectromicroscopy techniques such as photoemission electron microscopy (PEEM), scanning transmission x-ray microscopy (STXM) or full field x-ray microscopy add spatial resolution down to a few nm. It is obvious that using spectroscopic information for magnetometry and magnetic microscopy requires the detailed theoretical understanding of spectral shape and magnitude of dichroism signals.

We present the observation as well as theoretical description of anisotropic x ray magnetic linear dichroism (XMLD) at the Ni L3,2 edges in NiFe2O4 and NiO as well as at the Fe L3,2 edges in Fe3O4 [1]. We show unambiguously that - contrary to current belief - spectral shape and magnitude of the XMLD is not only determined by the relative orientation of magnetic moments and x ray polarization but that their orientation relative to the crystallographic axes has to be taken into account for the accurate interpretation of the XMLD data.

The observed anisotropy of XMLD is a general phenomenon and is expected for any magnetic system. Consequently, conclusions based on the interpretation of XMLD spectra without accounting for the XMLD anisotropy have to be reconsidered. We will revisit some of the previous experimental results and reinterpret the experimental data based on our findings.

[1] E. Arenholz et al., Phys. Rev. B 74, 094407 (2006) and submitted.

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