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Intensity-based Wide-field Magneto-optical Microscopy

Schäfer Rudolf

Leibniz Institute for Solid State and Materials Research (IFW) Dresden, Helmholtzstrasse 20,D-01069 Dresden, Germany and Institute for Materials Science, Technische Universita t Germany Dresden, D-01062 Dresden

ABSTRACT

In conventional Kerr- and Faraday microscopy the sample is illuminated with plane-polarized light and a magnetic domain contrast is generated by an analyzer making use of the Kerr- or Faraday rotation. In this presentation we review possibilities of analyzer-free magneto-optical microscopy based on magnetization-dependent intensity modulations of the light: (i) The transverse Kerr effect can be applied for in-plane magnetized material, demonstrated for an FeSi sheet. (ii) Illuminating the same sample with circularly polarized lightleads to a domain contrast with a different symmetry as the conventional Kerr contrast. (iii) Circular polarization can also be used for perpendicularly magnetized material, demonstrated for a garnet film and an ultrathin CoFeB film. (iv) Plane-polarized light at a specific angle canbe employed for both, in-plane and perpendicular media. (v) Perpendicular light incidence leadsto a domain contrast on in-plane materials that is quadratic in the magnetization and to a domain boundary contrast. (vi) Domain contrast can even be obtained without polarizer. In cases (ii) and (iii), the contrast is generated by MCD (Magnetic Circular Dichroism, i.e. by thedifferential absorption of left and right circularly polarized light, induced by magnetization components along the direction of light propagation) while MLD (Magnetic Linear Dichroism,
i.e. by the differential absorption of linearly polarized light, induced by magnetization components transverse to the propagation direction) is responsible for the contrast in case (v). The domain boundary contrast is due to the magneto-optical gradient effect in metallic samples.A domain boundary contrast can also arise due to interference of phase-shifted magneto-opticalamplitudes.
All reported contrasts can be applied directly for domain imaging. In any case they need to be considered also in conventional magneto-optical Kerr microscopy and MOKE magnetometry as they can be superimposed on any regular Kerr signal.

References

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