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Soft x-ray characterization of structural and magnetic heterogeneity in thin films and multilayers

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The element-specificity of resonant magneto-optical effects near core levels in the x-ray range offers numerous opportunities to study the structure and magnetism in thin films and multilayers. By combining reflectivity and small-angle scattering (SAS), variations in both the structural and magnetic properties of heterogeneous films can be determined. At the 1-2 nm wavelengths of interest, SAS is readily measured from lateral inhomogenieties with dimensions comparable to or greater than these wavelengths. In this talk we report recent SAS results obtained from magnetic thin films and multilayers of interest for magnetic storage. The SAS experiments were performed at the Advanced Light Source and provide a quantitative approach to obtain statistically averaged structural parameters such as average grain size and grain-size distributions. By tuning near resonances of selected elements, the scattering contrast can be enhanced and element specific information (both structural and magnetic) determined. These approaches are applied to explore the chemical segregation in CoPtCrB recording media and FePt and TbFeCo films. In appropriate geometries, resonant SAS also arises from magnetic domains. Examples of magnetic scattering from perpendicular $CoPt_3$ films and Co/Pt multilayers will be presented and correlated to atomic and magnetic force microscopy images.

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