

NANOSCIENCE COLLOQUIUM

Magnetic hard X-ray spectroscopy of nanoparticles

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Abstract: In past years a growing number of experimental stations capable to perform photon-in/photon-out (PIPO) spectroscopy experiments was constructed at synchrotron light sources and X-ray free electron lasers around the world. These instruments provide insights into X-ray absorption that arises from a transition from an inner-shell atomic orbital to an unoccupied orbital simultaneously with X-ray emission that occurs when an inner-shell vacancy is filled by an electron from a shallower inner-shell atomic or valence orbital. PIPO spectroscopy provides rich information on the electronic structure with element specificity, particularly on electronic occupation and coordination environment of an element. When probed with circularly polarized incident light it is also sensitive to magnetic order.

In my talk I will focus on basics and applications of hard X-ray PIPO magnetic spectroscopy, namely 1s2p RIXS-MCD, which is a valuable method to probe magnetic materials of complex internal structure or using demanding sample environments. In particular, I will present how it can be used to derive element selective magnetization profiles of magnetic nanostructures, which are free from uncertainty related to the contribution of matrix/substrate or carrier fluid (figure). Such profiles provide an elegant way to derive the distribution of magnetic diameters of superparamagnetic nanoparticles, to quantify the internal structure and distribution of anisotropies in core/shell magnetic nanoparticles, and to determine interparticle interactions in ferrofluids. I will also discuss the feasibility of in-situ PIPO spectroscopy study of the evolution of structure and magnetic properties of nanoparticles during solution synthesis.

