Imaging magnetic responses of three-dimensional nanomagnets by XPEEM

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Photoelectron microscopy in combination with synchrotron light (XPEEM) is a well established imaging technique. Its specific contrast is widely used for magnetic imaging and microspectroscopy with quantitative analysis. I will present advanced PEEM concepts to address the structure-function relationship in magnetic nanostructures. A crucial point in magnetic imaging is the application of magnetic fields. Many experiments require observation of magnetic responses or the preparation of a certain magnetic state during the measurement. We developed a series of magnetic sample holders to apply magnetic fields of 50mT and more during imaging. I will demonstrate how we can use such tools to image magnetic responses of individual Fe nanocubes, (18nm)^3 in size. Comparing responses of nanocubes in different local coordination allows us to investigate the influence of dipolar coupling between neighboring nancoubes.

Imaging of such three-dimensonal objects as nanocubes, nanotubes, etc., with PEEM is often limited by the probing depth of photoelectron yield detection (5-10nm). The bulk magnetization of larger structures can not be accessed by conventional PEEM imaging. I will present a combination of surface sensitive PEEM imaging with a transmission experiment providing full access to the inner part of the nanostructure. This enables us to investigate three-dimensional magnetization configurations in core-shell nanostructures. I will present a recent PEEM study of magnetization configurations in coaxial nano-magnets, consisting of an iron oxide tube and an enclosed nickel core.