EE 298-12
Solid State Technology and Devices Seminar

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1-2pm
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Soft X-ray microscopy: Facing the mesoscale challenge in magnetism

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Abstract

Over the last decade magnetism research focused on a fundamental understanding and controlling spins on a nanoscale. Recently, it has been recognized, that the next step beyond the nanoscale will be governed by mesoscale phenomena [1], since those are supposed to add complexity and functionality, which are essential parameters to meet future challenges in terms of speed, size and energy efficiency of spin driven devices. The development and application of multidimensional visualization techniques, such as tomographic magnetic imaging and investigations of fast and ultrafast spin dynamics down to fundamental magnetic length and time scales with elemental sensitivity in emerging multi-component materials will be crucial to achieve mesoscience goals.

Magnetic soft X-ray microscopy is a unique analytical technique combining X-ray magnetic circular dichroism (X-MCD) as element specific magnetic contrast mechanism with a spatial (2D and 3D) resolution down to currently about 20nm. In addition, utilizing the inherent time structure of current synchrotron sources fast magnetization dynamics in ferromagnetic elements can be performed with a stroboscopic pump-probe scheme with 70ps time resolution [2,3].

To demonstrate the capabilities of magnetic soft x-ray microscopy I will review in this talk recent studies of magnetic vortex structures, where we found a stochastic character in the nucleation process, which can be described within a symmetry breaking DM interaction [4]. I will also present time resolved studies of dipolar coupled magnetic vortices, where we found an efficient energy transfer mechanism, which can be used for

novel magnetic logic elements [5]. First attempts to image the 3dim magnetic domain structures in rolled-up Ni nanotubes are very promising [6].

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