Magnetic Domains and Magnetization Dynamics Imaged Using a High-Resolution X-ray Photoemission Electron Microscope (X-PEEM)

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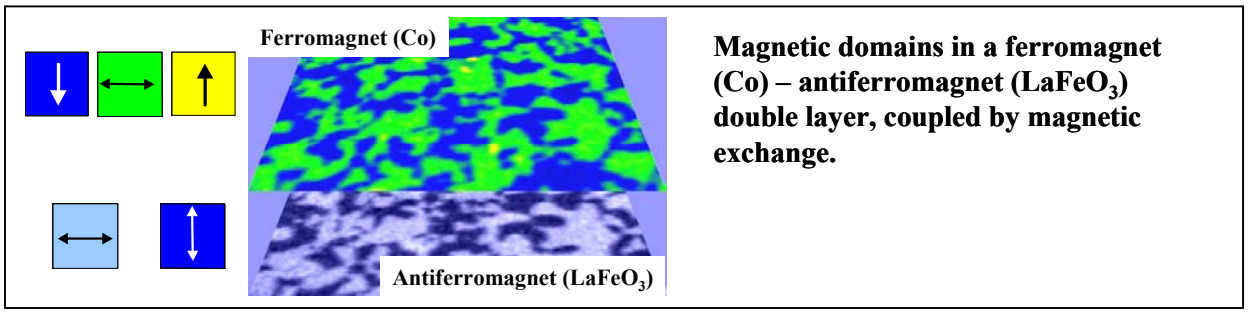
The exchange length and the precession frequency of the magnetization determine the fundamental length and time scales of a magnetic system: Nanometers and Picoseconds. X-ray spectromicroscopy, which provides spectroscopic information on a nanometer scale, is uniquely suited for the microscopic study of the properties of complex magnetic systems because of its key strengths: element specificity and quantitative magnetic sensitivity to ferromagnets and antiferromagnets.

Firstly I will introduce the X-ray PEEM technique and its application to multi-domain, layered systems, employing magnetic linear and circular dichroism. I will present domain images of antiferromagnetic materials and will review implications to the old problem of exchange bias at the ferromagnet/antiferromagnet interface.



Magnetic domains in a ferromagnet (Co) – antiferromagnet ($LaFeO_3$) double layer, coupled by magnetic exchange.

Subsequently, I will introduce a new approach to the investigation of nanoscale magnetization dynamics using x rays. The pulsed nature of synchrotron radiation facilitates 2-color pump-probe experiments with 50 ps time resolution. A fast heating, a current or a field pulse is first generated by a pulsed infrared laser and stimulates a magnetic response, which is then repetitively imaged using a synchrotron pulse at a fixed time delay. This stroboscopic method is similar to optical probe techniques, but offers superior spatial resolution and element specificity to only list a few advantages. I will show first results and will then discuss exciting applications for this new technique.