

The Grand Challenges in Nanomagnetism

Presented by

Sam Bader

at the

NNI Workshop on X-rays and Neutrons

June 16, 2005

Washington, DC



Argonne National Laboratory



*A U.S. Department of Energy
Office of Science Laboratory
Operated by The University of Chicago*





Which of the outstanding problems in nanoscale synthesis, structure, dynamics and properties can be addressed using x-ray and neutron techniques such as scattering, imaging and spectroscopy, and how can these techniques help illuminate the important and urgent issues at the nanoscale?

Neutron scattering continues to be a powerful tool to understand magnetic superlattices and multilayer systems. In the future neutron scattering can be extended to study surfaces via in-situ (UHV) grazing incidence experiments. Also, patterned systems can be studied in diffraction mode with the neutron wavelength matched to the pattern spacing. Neutron Scattering also can be used to characterize hybrid systems grown on polymeric or bio templates.

The x-ray technique with great promise for studying nanomagnetic systems, including dynamics, is PEEM. The community eagerly awaits the next-generation PEEM facility at the ALS. It will have state-of-the-art spatial as well as temporal resolution capabilities. This will open new scientific horizons.

These techniques will help answer the questions: Where are the atoms?
Where are the electrons? Where are the spins?

How might the current resource base in X-ray and neutron techniques be augmented and used in solving outstanding problems in nanoscale characterization?

The key enabler is the existence of high-quality samples that are worthy of being studied via advanced characterization tools. The nanocenters will add great value to the x-ray and neutron facilities because they will largely be dedicated to create the new materials and hybrid systems that will define a good piece of the future of materials research.

It is however important to focus a critical mass of attention on a few key systems in order to make proper progress.