DB01

Turbulent Transitions and Frustrated States: Some Issues in Reversal

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A trend over the last few decades in many areas of science and technology has been to modify and control material properties through careful choice of dimensions. A key feature of such endeavors is to create useful physical properties governed by surfaces and interfaces. Important length scales in magnetic metals are spin diffusion, which ranges from angstroms to nanometers, and exchange lengths, which can be on the order of several nanometers. Advanced techniques now allow us to create structures on these length scales in three dimensions. This is a remarkable achievement because it often represents true atomic level engineering, and is based on years of detailed study of thin films and multi-layers.

A rich wealth of fascinating phenomena has emerged from studies of these types of constrained geometry structures within the contexts of high speed magnetization reversal and magnetic domain stability. This lecture will provide an introduction to essential concepts, illustrate examples of new physics, and present some challenging, unanswered questions. Topics will include examples of frustration in exchange bias systems and analogies to spin glasses; control of nonlinear processes in patterned magnetic structures and parametric processes incurred during high speed reversal; pinned and viscous domain wall motion in ultra-thin films and nanowires; and electronic and spin wave transport through domain walls. These examples will illustrate reversal processes and domain stability issues relevant for a wide variety of magnetic device applications, including concepts being explored for novel spin logic schemes.

Robert Stamps received BS and MS degrees from the University of Colorado, and a PhD in Physics from Colorado State University. He has taught at the University of Colorado, Ohio State University, and has been with the University of Western Australia since 1997 where he is now Associate Professor in Physics. Dr Stamps has held a Humbolt Junior Fellowship at RWTH Aachen, CNRS Professorial Fellowships (Strasbourg and Orsay), CNR Fellowship (Florence), a University of Paris VII Visiting Professorship, and received a Faculty Excellence in Teaching award in 2001. His work on exchange bias and magnetization dynamics featured in his tenure as the 2004 Wohlfarth Lecturer. Professor Stamps has published over 140 papers on a range of topics in magnetism, including linear and nonlinear dynamics of magnetic and ferroelectric nanostructures, frustrated spin systems and spin glasses, inelastic light scattering and ferromagnetic resonance, spin electronics and domain wall dynamics in constrained geometries and random systems. He is a member of the IOP, Australian AIP, and IEEE Magnetics Society, chair of the 2007 MML Symposium, and currently serves on the advisory editorial board of the Journal of Magnetism and Magnetic Materials.

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Spin Transfer Driven Dynamics of Magnetic Domain Walls in Magnetic Nanowires

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A comprehensive understanding and control of the magnetization dynamics in magnetic nanostructures is key to the development of novel memory and logic devices. New paradigms for DW-based devices are made possible by the direct manipulation of DWs using spin polarized electrical current via spin transfer torque. We have studied the field and current driven dynamics of domain walls (DWs) in magnetic nanowires in pursuit of magnetic racetrack memory[1]. The DW dynamics excited by magnetic field and/or spin polarized current are studied by measuring both the static and time resolved resistance of the nanowire. We show the controlled motion of a series of domain walls along magnetic nanowires using current pulses in permalloy nanowires. Successive creation, motion and detection of multiple domain walls by using sequences of properly timed nanosecond long current pulses are carried out. A three bit magnetic shift register is constructed to demonstrate the basic concept of the Racetrack Memory[2]. Fascinating effects arising from the interplay between DWs with spin polarized current will be discussed.

REFERENCES

[1] S. S. P. Parkin *et al*., Science **320**, 190 (2008).
[2] M. Hayashi *et al*., Science **320**, 209 (2008).