MAR07-2006-020157

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

The Spin Transfer Torque Critical Current in Magnetic Nanopillars[1]

ANDREW KENT, Department of Physics, New York University

Spin transfer in magnetic nanopillar has become a major focus of experimental research since Slonczewski and Berger's seminal theoretical work in 1996. A spin current has been demonstrated to switch the magnetization direction of a small magnet at a specific current density, as well as to induce microwave excitations. However, there are basic questions about the factors that control the critical current density for magnetization dynamics. For instance, in Slonczewski's model, spin angular momentum transfer occurs at ferromagnetic/non-magnetic interfaces and competes with bulk magnetization damping. This model predicts a critical current that scales linearly with ferromagnet layer thickness and extrapolates to zero in the limit of zero thickness. In this talk I will present experiments on Co (10 nm) /Cu (10 nm) /Co (t) nanopillars in which the Co free-layer thickness, t, has been varied from 2 to 5 nm. The critical current has been studied at low-temperature as a function of applied magnetic field perpendicular to the plane of the layers. The critical current decreases linearly with decreasing free-layer thickness, but extrapolates to a finite critical current in the limit of zero thickness, while the junction magnetoresistance is independent of thickness [1]. The limiting current is in agreement with that expected due to a spin-pumping contribution to the magnetization damping. It is also consistent with our FMR studies of Co films, which indicate an enhancement of the magnetization damping in ultra-thin ($<$ 4 nm thick) Co layers due to spin-pumping [2]. Finally, I will discuss more recent studies of nanopillars with Ni/Co multilayer free layers. In these experiments, the role of the magnetic easy plane anisotropy can be explored, as this anisotropy varies with the number of Ni/Co interfaces within a fixed film thickness [3].

1. W. Chen, et al., Phys. Rev. B 74, 144408 (2006)
2. J-M. Beaujour et al., Phys. Rev. B 74, 214405 (2006)
3. J-M. Beaujour et al., cond-mat/0611027

[1]In collaboration with J. Z. Sun (IBM), W. Chen and J-M. Beaujour (NYU). Supported by NSF-DMR-0405620.