The Department of Physics and Astronomy
Presents Research Seminar Speaker

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Friday January 22, 2010
Time: 3:00-4:00 p.m.
Location: MB 0.302

Magnetic and Semiconductor Nanostructures and Devices for Ultrahigh Density Recording

Magnetic storage technology aims to achieve recording densities > 10^{12} bits/in^2 (1.6 x 10^{11} bits/cm^2) in the foreseeable future. The dimensions of the magnetic domains at this density will be ~ 15 – 20 nm in diameter. These nanoscale dimensions present major challenges in engineering material properties for both the thin films utilized for storing the bits, and to the sensors employed to reliably detect the minute magnetic fluxes emanating from such nanoscale domains. These include fundamental physical limits of ferromagnetic materials on account of the reduced dimensionality, as well as nanofabrication challenges to attain the minimum feature size with the stringent tolerances required.

This talk will review ongoing efforts to produce highly uniform nanostructured magnetic thin films comprising magnetic grains of < 5 nm in diameter, segregated by a secondary non-magnetic phase. One approach utilizes nanolithography via self-assembled polymer templates to generate bit patterned media, whereas the alternative approach aims to improve the microstructure of the recording materials by controlling the nucleation process. As higher magnetic anisotropy materials will be required for overcoming the thermal stability limit of the nanoscale grains, the need for additional write assist methods such as thermal assisted recording will be discussed.

Mesoscopic sensors based on GMR ,TMR and spintronic devices employing ferromagnetic layers are expected to be inadequate for sensing 15 nm diameter domains on account of mag noise and spin-torque effects. Therefore, magnetic sensor devices employing non-ferromagnetic materials are needed. Nanoscopic semiconductor quantum well heterostructures offer a potential solution and I will describe our ongoing research in this area.