Depth Control of Ferromagnetism in FePt3 Films by Ion-Irradiation

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The roadmap which outlines storage technology of magnetic hard disk drives predicts storage densities above 5 Tb/in^2 to be realised by isolated, individually addressable ferromagnetic (FM) bits of <10 nm in lateral dimension. In principle, artificially patterned structuresof this type can be manufactured by x-ray, ion-and electron-beam lithography. However, there may be alternative solutions for obtaining these regular, nanoscale patterns of isolated FM dots. Our proposal is to locally transform a non-magnetic layer into a pattern of geometrically defined FM islands. Such a phase transition could be initiated by locally changing some physical parameter of the layer, such as its strain state or chemical composition leading to ferromagnetism. Here, we present a chemical order (paramagnetic) to chemical disorder (FM) phase transition stimulated by He^+irradiation of a $FePt_3$ thin film.

This talk will present preliminary work focussing on depth profiling the ion-beam induced FM order. By controlling the energy (15 keV) and fluence ($2x10^{16}$ ions/cm^2) of the ion-beam,we show ferromagnetismcan be locally induced into the upper-half volume of the initially chemically well-ordered 280 nm $FePt_3$ film.Polarised neutron reflectometry was used to investigate the depth dependence of the layer averaged ion-beam induced FM moment within the thin film. Data analysis of the Kiessig fringes observed in the reflectivity post-irradiation suggest the FM / nonmagnetic interface is atomically sharp.The resultingbilayer structure was found to be homogenous in chemical composition but heterogeneous in both chemical and magnetic orders.