MAR05-2004-006461

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

Magnetism of nano-alloys with Stoner interaction enhanced elements[1]

OLEG MRYASOV, Seagate Research

Rapidly decreasing grain size of data storage media stimulate research targeted on understanding the factors controlling performance of magnetic metallic alloys at sub 8 nm lengths scale. We discuss a few specific examples where it is necessary to consider atomic scale finite size effects and correspondingly to develop a quantitative model of magnetic interactions. We present results of modeling motivated by the advances in preparation and characterization of $L1_0$ FePt, FePd, and CoPt alloys as well research on the meta-magnetic transformation in FeRh to be usedthe Heat Assisted Magnetic Recording (HAMR) recording process. The use of a multi-scale modeling approach which combines a microscopic model of the magnetic interactions and statistical modeling/theory techniques enables us to investigate the thermomagnetic process for 2-8 nm nano- particles. The microscopic model of the magnetic interactions is calibrated with measurements of the temperature dependent magnetic properties for nano-particulate and granular FePt thin films. The analysis of these experimental results uncovers the mechanism of the large magnetic anisotropy as being dominated by the two-ion contribution. In the case of FeRh, isotropic exchange interactions mediated by the induced moment of Rh atoms is found to increase with thermal fluctuations. This, along with a large Stoner intra-atomic exchange parameter results in an unusual M (T) dependence. We show that proposed microscopic mechanism of the AF-FM transformation explains the well established observations. The proposed model of isotropic and anisotropic magnetic inter-atomic interactions mediated by the Stoner intra-atomic interaction enhanced elements Pt, Pd and Rh is shown to be capable of explaining the unsusual finite size and temperature dependent magnetic properties of these nano- alloys.

[1]in collaboration with U. Nowak and R. Chantrell