Probing SFD of Bit Patterned Media Using EHE Measurement

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Abstract

Ordered arrays of isolated magnetic nanostructures are of considerable interest to increase the storage density of hard disks beyond the current perpendicular media. In such bit patterned media (BPM), each artificially fabricated magnetic nanostructure is capable of storing an individual bit. Recently, we developed a novel non-lithographic method to fabricate perpendicularly magnetized BPM system [1] and we studied Co/Pt bit pattern media [1-2]. In present work, we fabricated a perpendicularly magnetized bit pattern media using the barrier layer of auto-assembled anodic alumina template with 100 nm period and by depositing Ta(5nm)/Pt(5nm)/Co88Tb12(5nm)/Cu(2nm)/Pt(5nm) to form an ordered array of ferromagnetic nanodots, so-called nanobumps. We used extraordinary Hall Effect (EHE) measurements to probe magnetization reversal mechanism and switching field distribution (SFD) of these nanobumps. The extraordinary Hall resistivity measurements were performed by a standard four-probe method. The role of interdot exchange coupling and dipolar coupling are investigated using EHE measurement. The measurement of the coercivity as a function of magnetic field angle with respect to the sample surface reveal that it follow Stoner-Wohlfarth model with a shallower variation, which is typical of a dot-by-dot reversal but with a nucleation/propagation process for each dot. In order to further distinguish and quantify the switching field distribution origins (SFD), we used the ΔH (M, ΔM) method, to separate the intrinsic SFD from interaction effects. This fitting demonstrates that the intrinsic SFD ($\sigma_{intrinsic}$ = 14 .1mT) is only about one-third of the overall SFD (37 mT). Our result show that the intrinsic SFD is only one-third of the total SFD. The strong dipolar-induced SFD is due to the close packing of the AAO template and might be a showstopper for a BPM technology implementation. We think that the present AAO system could be a model for getting a deeper understanding of the influence of the different thin film parameters (exchange coupling, dipolar interaction, and, more importantly, intrinsic SFD or thermal fluctuations) on the reversal mechanisms in PMA films.

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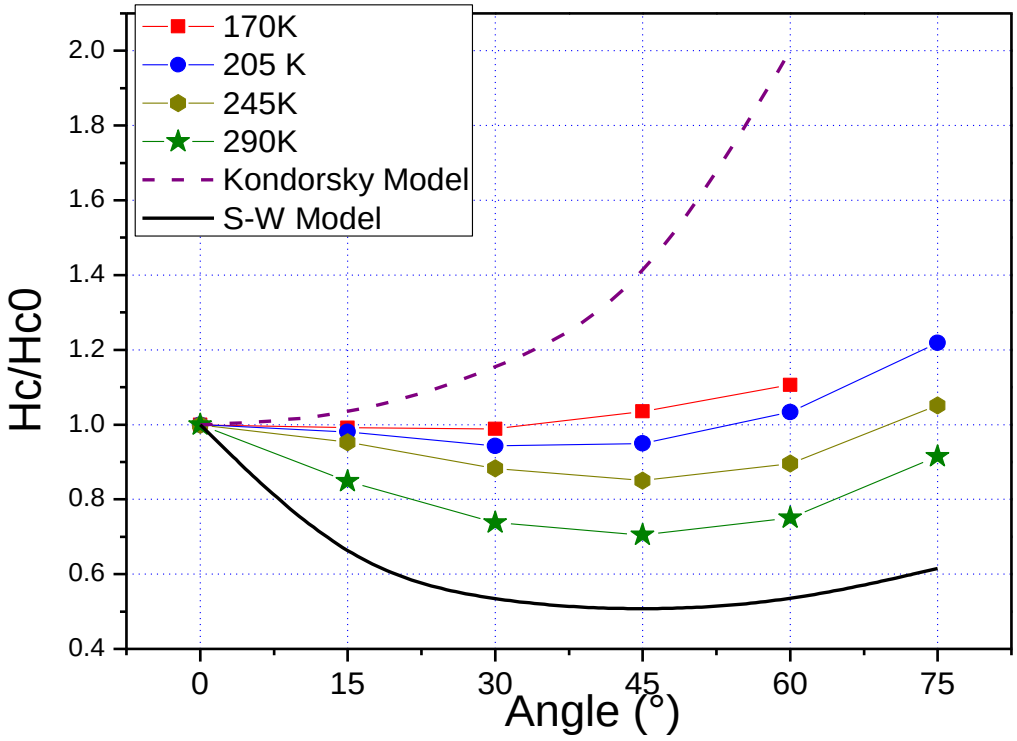

Figure 1: Variation of coercivity as a function of the angle of the applied field measured at 170, 205, 245 and 290 K for 100 nm lateral size with a CoTb Alloy deposited on top. The black continuous line is the prediction of switching field in the Stoner-Wohlfarth model and dotted line is the for Kondorsky model

References:

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