Switching field distribution of FePt-C/FePt exchange coupled perpendicular media

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Since the grain size of the recording media has to be reduced, a magnetic material with high K_u must be applied for the concern of thermal stability. However, high K_u media require high writing field in order to write the information onto the media. Due to the physical limitation where the maximum attainable head field is about 1.7 T [1], the writability of such media becomes a challenge. In this work, by increasing FePt soft layer thickness in FePt-C/FePt exchange coupled granular/continuous (CGC) perpendicular media, we successfully reduced the coercivity field from 4.9 to 1.4 T without sacrificing thermal stability. Meanwhile, the switching field distribution (SFD) of the bilayer media also got significant improved. Both of these advantages make FePt-C/FePt CGC media here a potential candidate for extremely high areal density recording media which is writable meanwhile thermal stable.

FePt-C 10 nm/FePt X nm exchange coupled granular/continuous perpendicular bilayer films were DC magnetron sputtered on single-crystalline MgO (001) substrates. Bottom hard layer was deposited by the co-sputtering using Fe, Pt and C targets at a substrate temperature of 600°C under 0.48 Pa Ar while the top relative soft FePt layer was sequenced co-sputtered at a lower substrate temperature of 400°C. The soft FePt layer thickness was varied from 2 to 15nm.

Figure 1 shows the in plane and cross-sectional TEM images of MgO(001)/FePt-C 10nm/FePt Xnm CGC perpendicular bilayer films with different soft FePt capping layer thickness. Fig.1 (a) & (b) illustrate the TEM images of single FePt-C 10nm layer without soft capping layer. One can see that the single FePt-C layer gives a well-isolated nano granular structure with average grain size around 10.2 ± 1.5 nm (Inset of Fig. 1a). For bilayer film with 5 nm capping soft FePt layer, due to the inter-diffusion at FePt-C/ FePt interface, FePt grains grow larger with average grain size around 12 nm and the capping soft FePt growth epitaxially on the top of each individual hard FePt grains forming identical grains. Further increase the layer thickness to 10 or 15nm, one can detect soft FePt gains island on the top of bottom FePt grains, finally forming continuous soft FePt layer which is typically CGC structure. On the other hand, magnetization curves (Fig. 2) of the exchange coupled bilayer with various soft FePt layer thicknesses indicate that the introduced capping soft FePt layer also holds perpendicular magnetic anisotropy (PMA) and can effectively reduce the covercivity field Hc (4.9 to 1.4T) though direct exchange coupling at the FePt-C/ FePt interface. Furthermore, SFD analysis with ΔH (M, ΔM) method [2] shows that the direct exchange coupling at the interface can significantly narrow the SFD (33% to 6%) by increasing soft FePt layer thickness. However, decline of SFD with 15nm capping soft FePt layer can be attributed to the degradation of PMA.

Reference

1) Koji Matsumoto, Akhihiro Inomata, and Shin-ya Hasigawa, Fujitsu Scientific & Technical Journal 42, 158 (2006).

2) A. Berger, B. Lengsfield and Y. Ikeda, J. Appl. Phys., 99, 08E705. (2006).

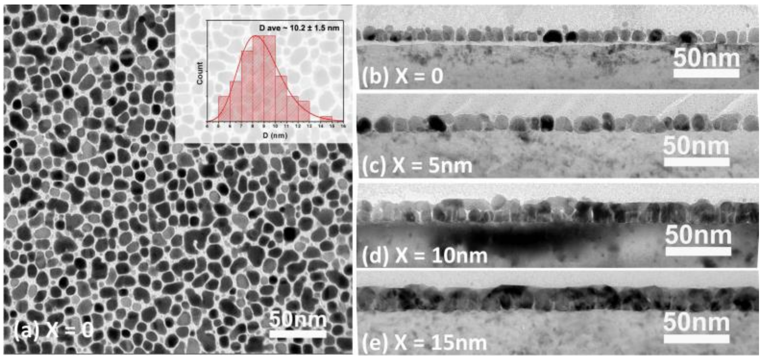

Fig. 1 In plane and cross-sectional TEM images of FePt-C10nm/FePt Xnm exchange coupled media (Inset: FePt grain size distribution)

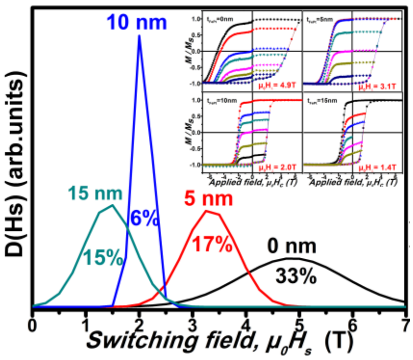

Fig.2 Switching field distribution and corresponding out-of-plane magnetization curves of FePt-C 10 nm/FePt X nm exchange coupled media.