Mechanism of coercivity enhancement by Ag addition in FePt-C granular media for heat assisted magnetic recording

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FePt granular thin films are considered to be one of the suitable candidates for ultrahigh density perpendicular recording media beyond 1 Tbits/in^2 because of the high magnetocrystalline anisotropy of the $L1_0$-FePt phase (~7×10^7 erg/cc). We previously reported highly $L1_0$-ordered FePtAg–C nanogranular film as a potential high-density storage medium for heat assisted magnetic recording (HAMR) [1,2]. Although the addition of Ag is known to increase the H_c, the mechanism of H_c enhancement is not clarified yet. In this paper we investigated the Ag distribution in FePtAg-C granular films by aberration-corrected scanning transmission electron microscope-energy dispersive X-ray spectroscopy (STEM-EDS) and X-ray absorption fine structure (XAFS).

$(FePt)_{0.9}Ag_{0.1}$-28vol%C (FePtAg-C)and FePt-28vol%C (FePt-C) granular films were deposited by co-sputtering Fe, Pt, Ag and C targets on a pre-deposited glass/*a*-NiTa/MgO substrates at 600°C. In this work, we employed a new alternating layer deposition technique to control the grain growth in the perpendicular direction suppressing the growth of the randomly oriented spherical particles on the [001] textured FePt granular layer. The film stack was glass/*a*-NiTa(60nm)/MgO(15nm)/$[(FePt)_{0.9}Ag_{0.1}$-48vol%C or FePt- 48vol%C(0.25)/FePt(0.15)$]_{25}$ deposited on a heat resistant glass substrate [3]. Figure 1 shows the in-plane and out-of-plane magnetization curves of (a) FePt-C and (b) FePtAg-C films. Both of the films show strong perpendicular anisotropy due to the strong c-axis texture. Coercivity H_c of FePt-C and FePtAg-C films are 3.0 and 3.9 T, respectively. TEM bright-field images (not shown here) indicated that FePt-C and FePtAg-C show well-isolated uniform microstructure with average particle sizes are 10.5 nm and 10.0 nm, respectively. The higher H_c in the FePtAg-C film in spite of the similar microstructure is attributed to the higher degree of $L1_0$ ordering. Figure 2 shows STEM-EDS elemental maps of (a) Fe, (b) Pt, (c) Ag and (d) a combined map of Fe and Ag in the FePtAg-C film. The elemental mapping shows that FePt particles are enveloped by Ag-rich shells. EXAFS results showed that Ag shells have fcc-like structure. From these details analysis, we can conclude that Ag is rejected from the core of FePt grains during the deposition, forming Ag-enriched shell surrounding $L1_0$-ordered FePt grains. Since Ag has no solubility in both Fe and Pt, the rejection of Ag induces atomic diffusions thereby enhancing the kinetics of the $L1_0$-order in the FePt grains [3].

Reference

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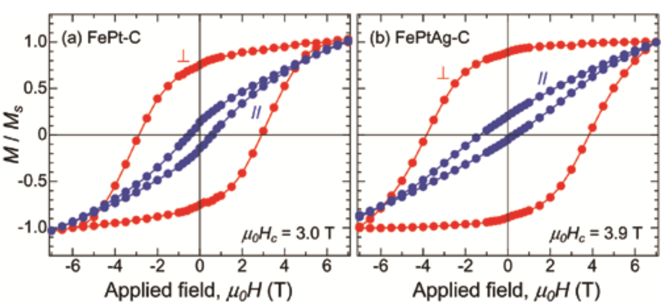

Figure1. In-plane and out-of-plane magnetization curves of (a) FePt-C and (b) FePtAg-C granular films.

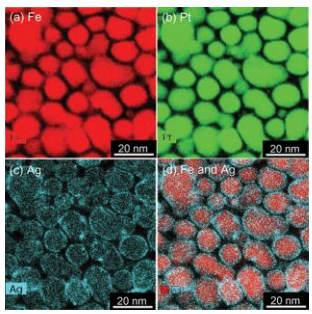

Figure 2. EDS mappings of (a) Fe, (b) Pt, (c) Ag and (d) Fe and Ag of FePtAg-C granular film.