Effect of CrB insertion on the (001) texture of MgO seed layer and magnetic properties of FePt-C HAMR media

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$L1_0$-ordered FePt-C granular films are considered to be the most promising candidates for heat-assisted magnetic recording (HAMR) media for the recording density higher than 1.5 Tbit/in^2. For practical applications as HAMR media, the FePt-C granular structure has to be optimized with excellent alignment of the c-axis normal to the film plane on polycrystalline MgO seed layer. Therefore it is essential to have a strong (001)-texture in the MgO seed layer with a smooth surface. In our previous work[1)], we demonstrated well-isolated FePt-C granular films with high $\mu_0 H_c$ on polycrystalline MgO underlayers. However, poor (001)-textures of polycrystalline MgO seed layers result in serious mis-orientations of FePt grains, causing large in-plane components in the magnetization curve, which will lead poor SNR[2)]. Here, we show that with the insertion of a 2-nm-thick CrB layer between a heat sink and a MgO seed layer, the texture and the surface roughness of the MgO seed layer are significantly improved, thereby reducing the in-plane component in a subsequently deposited FePt-C granular layer.

6-nm-thick FePt-28vol.% C films were deposited by DC co-sputtering using FePt and C targets at 600°C under 0.48Pa Ar on a MgO (100) substrate (Sample A), glass/ NiTa (100 nm)/ MgO (10 nm) seed layer (Sample B), and glass/ NiTa (100 nm)/ CrB (2 nm)/MgO (10 nm) seed layer with a CrB insertion (Sample C). The MgO seed layers were RF sputter deposited under an Ar pressure of 5.2 Pa at room temperature (RT) using a MgO target.

Figure 1 shows the MgO (002) rocking curves of sample B and C. The insertion of a CrB layer obviously improved the (001)-texture of the MgO layer, which is indicated by the smaller FWHM value of the MgO (002) rocking curve (5.6° to 3.9°). The insertion of a CrB layer improves the roughness of the MgO seed layer from R_a value of 0.28 to 0.14 nm. The MH curves of the FePt-C layers grown on these two kinds of seed layers are shown in Fig. 2. Without the CrB layer (Fig. 2 a), the loops show small kink at zero field, and an open in-plane loop, indicating large in-plane components. In our previous work[2)], such large in-plane components were due to significant mis-orientation of FePt grains originated from mis-aligned MgO grains in a seed layer. With much improved (001)-texture and surface roughness of the MgO seed layer by the insertion of the CrB layer, sample C (Fig. 2 b) presents loops without kink, narrowed in-plane loop and reduced remanence ratio ($Mr_{//}$ / $Mr_{\perp}$) which are critical for signal-to-noise ratio of magnetic recording. In summary, the insertion of a thin CrB buffer layer on amorphous NiTa heat sink layer improves the (001)-texture and roughness of the MgO seed layer, which lead to the reduction in the in-plane component of the FePt-C recording layer.

Reference

1) A. Perumal, Y. K. Takahashi, and K. Hono, Appl. Phys. Express 1, (2008) 101301.
2) J. Wang, S. Hata, Y.K. Takahashi, H. Sepehri-Amin, B. Varaprasad, , T. Schrefl, K. Hono, Acta Mat., 91 (2015) 41

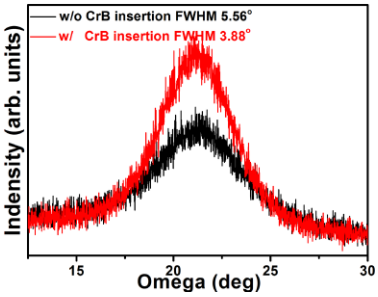

Fig. 1 MgO (002) rocking curves of films with (B) and without (C) CrB insertion layer.

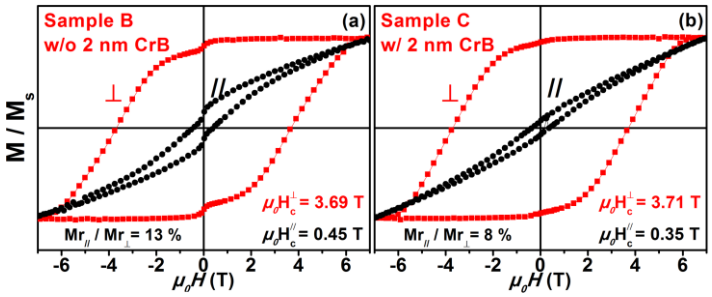

Fig. 2 M-H curves of sample B without 2 nm CrB (a) and sample C with 2 nm CrB insertion layer (b).