Surface segregation of Pt in $L1_0$-FePt nano-grains

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Heat assisted magnetic recording (HAMR) is the most promising candidate for the next generation high-density hard disk drives (HDDs). To increase the areal density to higher than 2 Tbit/in^2, $L1_0$-FePt granular media with a grain size of 4-6 nm is needed. However, the reduction of FePt grain size results in the reduction of the degree of $L1_0$ order [1], which causes the distribution of K_u in the FePt-C granular media with 4-6 nm grain size. This has been attributed to the existence of surface segregation of Pt, which deviates the stoichiometry composition of core region of $L1_0$-FePt grains [2,3]. A question raises here whether or not the chemical compositions of films can influence the surface segregation of $L1_0$-FePt grains. In this work, we have studied the influence of Fe concentration of $L1_0$-FePt grains to the surface segregation and the degree of $L1_0$ order.

FePt films with thickness of 8 nm was DC magnetron sputtered on single-crystalline MgO (001) substrate at the substrate temperature of 725°C. The input power for Pt target was kept constant at 16 W while the input powder of Fe target was varied from 30 W to 32 W to fabricate samples with Fe-lean, stoichiometric, and Fe-rich compositions. The magnetic properties of the samples were measured using a SQUID-VSM and the microstructures were characterized using an aberration corrected TEM (Titan G2 80-200)).

The Fe-lean sample showed a coercivity of 5.9 T while the Fe-rich sample showed slightly lower coercivity of 5.6 T. Figure 1 (a) and (b) show high resolution STEM-HAADF images obtained from the $L1_0$-FePt grains of the films with Fe-lean and Fe-rich compositions. In the STEM-HAADF images, the atomic columns with a brighter contrast correspond to Pt rich columns. Figure 1 (c) and (d) show STEM-EDS maps of Fe (green) and Pt (red) obtained from the surface of FePt grains for the Fe-rich and Fe-lean samples. The composition profiles obtained from line scans from the surface to the center of the grains are shown in Fig. 1 (e) and (f). STEM-EDS results show that Pt atoms enriches at the surface of $L1_0$-FePt grains which is due to surface segregation of Pt regardless of the composition of the film. The segregation of Pt to the surface region is to reduce the surface energy of the grains. How to suppress the surface segregation of Pt will be addressed.

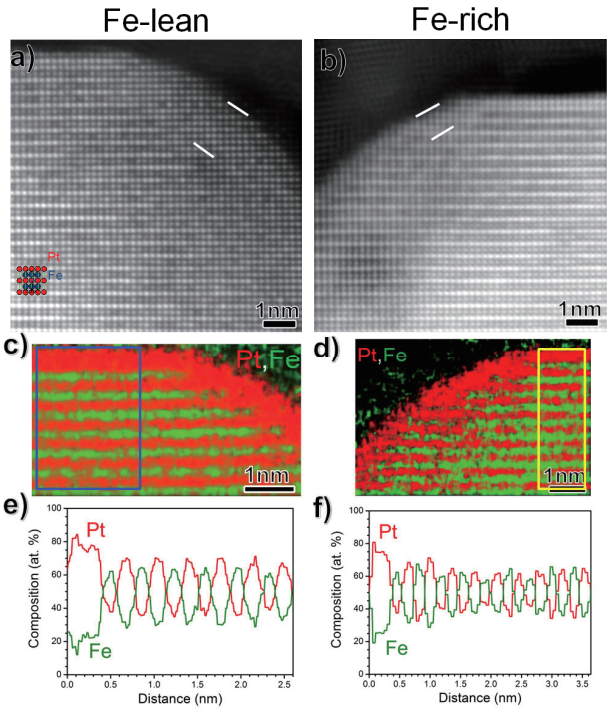

Fig. 1. (a) and (b) STEM-HAADF image, (c) and (d) STEM-EDS maps of Fe (green) and Pt (red), (e) and (f) EDS line profile calculated from selected lines shown in (c) and (d) obtained from the $L1_0$-FePt grains with Fe-lean and Fe-rich comp

[1] Y. K. Takahashi *et al.* J. Appl. Phys. 95 (2004) 2690.
[2] B. Yang *et al.* Scripta Mater. 53 (2005) 417. [3] T. Seki *et al.* Appl. Phys. Letters 82 (2003) 2461.