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Microscopic Aspect of Spin Reorientation Transition on Ni/Fe/Ni

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The magnetic anisotropy, which determines the preference of the magnetization direction, is a subject of great interest in magnetic thin films, and extensive efforts have been made to obtain the perpendicular magnetic anisotropy (PMA) due to a need for high density magnetic storage devices and magneto-optical recording media. In particular, a spin reorientation transition (SRT) through the modification of magnetic anisotropy is determined by the competition between interface magnetic and magnetoelastic anisotropy. Recently, a remarkable SRT phenomenon on Ni/Fe/Ni system was reported, showing a change of easy axis: in-plane → out-of-plane → in-plane. According to its SRT origin suggested by previous works [1,2], the interface magnetic anisotropy is dominant, while magnetic correlation between Ni and Fe is negligible. However, a fundamental understanding of interface magnetic anisotropy on SRT of Ni/Fe/Ni film is early stage, until now. In this work, we present results of comprehensive studies on SRT phenomenon modified the by interface magnetic anisotropy on Ni/Fe/Ni/W(110) films using the x-ray magnetic circular dichroism (XMCD) and the x-ray absorption spectroscopy (XAS) at Ni and Fe $L_{2,3}$-edges, and clarify the microscopic mechanism. Detailed description will be discussed in later presentation.

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CB06

Percolated Perpendicular Medium of FePt-MgO/Pt/Cr Trilayer Films for Ultra-High Magnetic Recording Beyond 1 Tbits/in^2

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The method of magnetic recording had switched from longitudinal magnetic recording (LMR) to perpendicular magnetic recording (PMR), in order to overcome the large demagnetizing field (H_d) and thermal instability at high linear density. In PMR, the direction of magnetic moments is perpendicular to the film plane. However, the area density of PMR cannot be increased arbitrarily; it is observed that area density above 500 Gb/in^2 causes thermal instability and transition noise [1]. To solve these problems, therefore, percolated perpendicular media (PPM) was proposed to further increase the area density in present hard disk drive platforms [2]. In this work, $(Fe_{48}Pt_{52})_{100-x}$-$(MgO)_x$ percolated films (x = 0 ~ 6.13 vol.%.) were deposited on textured Pt(001)/Cr(002) bilayer at 420 °C by magnetron sputtering. Fig. 1 shows the magnetic measurement results of FePt-MgO/Pt/Cr trilayer films. In Fig. 1(a), the saturated magnetization (*Ms*) decreases with increasing MgO content, due to the dilution effect. The perpendicular coercivity ($Hc_{\perp}$) drastically increases with increasing MgO content up to 0.15 vol. % and then decreases. The squareness ($S = Mr/Ms$) is almost 1 at 0.15 vol.% MgO doping. Further adding MgO to 6.17 vol.% lowered the value of S to 0.36, indicating that the *c*-axis alignments were destroyed at high MgO content. From the rocking curve, it is noteworthy that the FePt(001) alignments of 0.15 vol.% MgO doped FePt is similar with FePt. However, the increase in $Hc_{\perp}$ from 2.1 to 3.6 kOe implies different magnetization reversal behaviours in MgO doped FePt films. In order to characterize the magnetization behaviours, the initial magnetization curves of pure FePt film and an $(FePt)_{99.85}$-$(MgO)_{0.15}$ film were measured and shown in Fig. 1(d). The steeper increase of magnetization in $(FePt)_{99.85}$-$(MgO)_{0.15}$ film at a larger magnetic field, indicates stronger domain wall pinning effect caused by MgO nano-dots. The high-resolution transmission electron microscopy images revealed that the MgO dots of size ~ 3nm were evenly distributed in FePt matrix, thus acting as the pinning sites for domain wall motion. However, further increasing MgO content will turn PPM into granular perpendicular media (GPM) due to the segregation of excess MgO along FePt grain boundaries. Furthermore, to increase density of MgO dots and maintain the PPM properties, the MgO doped FePt films were also deposited on MgO(002) underlayer. Consequently, the MgO dots have more possibility to grow epitaxially along MgO(002) underlayer to become MgO column structure. From the experimental results, the $Hc_{\perp}$ also increases as MgO content increases to 0.76 vol. % and then decreases, which is similar to FePt-MgO/Pt/Cr trilayer films, but the MgO content with highest $H_{c\perp}$ postponed from 0.15 to 0.76 vol.%. Our experimental results support the validity of PPM structure for future magnetic recording medium with higher area density.

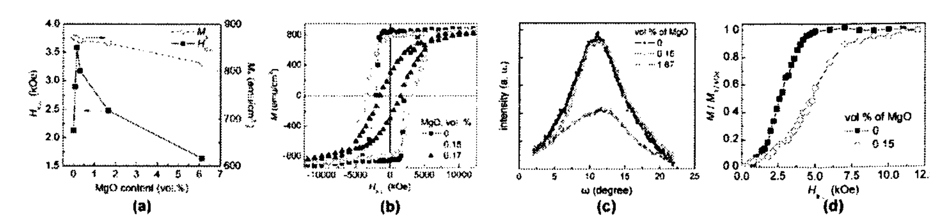

Fig. 1. (a) the $H_{c\perp}$ and Ms, (b) hysteresis loops, (c) rocking curves, and (d) initial curves of $(Fe_{48}Pt_{52})_{100-x}$-$(MgO)_x$ Pt(001)/Cr(002) trilayer films where the x = 0 ~ 6.13 vol.%.

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