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Microstructure and Magnetic Properties of FePt Films on Anodized Aluminum Oxide Membranes

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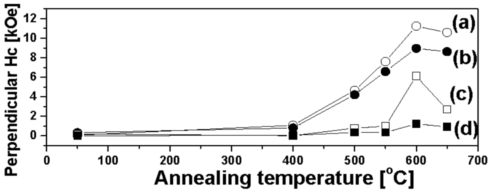
In pursuit of patterned recording media, magnetic nanomaterials fabricated through porous anodized aluminum oxide (AAO) have been widely investigated [1, 2]. In this study, FePt films were prepared on the AAO membranes with pore diameter of around 20nm and 200nm. In order to prevent the interdiffusion, a 10nm thick Au buffer was grown on AAO templates prior to FePt layers. Detail investigation on the XRD spectrum showed the 20nm pore diameter AAO template can assist the formation of Au (100) phase that resulted in the formation of FePt $L1_0$(001) phases under 600°C annealing. For all samples, the coercivity of FePt increased as increasing annealing temperature. However, the coercivity decreased while annealing temperature higher than 650°C. A large perpendicular coercivity, namely 11000 and 9000 Oe, was obtained in 600°C annealed FePt samples grown on 20nm and 200nm pore diameter AAO templates with Au buffer layers, respectively, as shown in Figs. (a) and (b). It is in a good agreement with the observation of FePt $L1_0$(001) phases. And a relative lower perpendicular coercive value, namely 6500 and 1000 Oe, was observed in FePt films directly grown on 20nm and 200nm pore diameter AAO templates, respectively, as shown in Figs. (c) and (d). That resulted from the interdiffusion between FePt and alumina. From these magnetic investigations, we concluded that a template with small pore diameter (or with large pore density) will enhance the coercive force (or domain wall pinning effect). In summary, we have observed experimentally the first time the structure and magnetism of FePt on AAO template. The Au (100) buffer layers and AAO templates will enhance the coercive force of FePt films through assisting the formation of $L1_0$(001) phases and providing extra pinning sites, respectively.



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Effects of SiN_x Content on the Microstructure and Magnetic Properties of FePt-SiNx Granular Thin Films

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$(FePt)_{1-y}(SiN_x)_y$ (y=0 ~ 63 vol.%) nanocomposite thin films are fabricated by dc and rf magnetron co-sputtering of Fe, Pt and SiN_x targets, then annealed at different temperatures and times. As the SiN_x content was increased from 0 vol.% to 63 vol.%, the behavior of the $(FePt)_{1-y}(SiN_x)_y$ films could be separated into three sections. First, as the SiN_x content is smaller than 15 vol.%, the FePt particles begin to be isolated partially and the particle sizes are not uniform. Second, as the SiNx content increases from 15 vol.% to 39 vol.%, the particle size distributions of FePt become more uniform. In these films, the SiNx matrix will impede the reverse of the spin moments of FePt. Therefore the high out-of-plane coercivity ($Hc_{\perp}$) and in-plane coercivity ($Hc_{//}$) of these films are due to pinning sites effect of SiN_x matrix. Third, as the SiN_x content is higher than 39 vol.%, the $Hc_{\perp}$ and $Hc_{//}$ of $(FePt)_{1-y}$ - $(SiNx)_y$ films decrease rapidly as the SiN_x content is increased. From a field emission gun high resolution transmission electron microscope (FEG-TEM) images of $(FePt)_{37}$ - $(SiN_x)_{63}$ film (as shown in fig.1), it is found that some particles are smaller than 5 nm (The bright regions and the dark regions of figure 1 are SiN_x matrix and FePt grains, respectively.). Some grains of this film may be smaller than D_p (minimal stable particle diameter) and cause the drastically decrease of Hc value. The $Hc_{\perp}$, $Hc_{//}$, out-of-plane squareness ($S_{\perp}$), and in-plane squareness ($S_{//}$) values of the $(FePt)_{37}$ - $(SiN_x)_{63}$ film are 6.5 kOe, 6.3 kOe, 0.75, and 0.45 respectively. And a uniform particle size distribution granular $(FePt)_{37}$ - $(SiN_x)_{63}$ film with an average particle size about 5 nm was obtained. This $(FePt)_{37}$ - $(SiN_x)_{63}$ film is a good candidate for application on high density perpendicular magnetic recording media.

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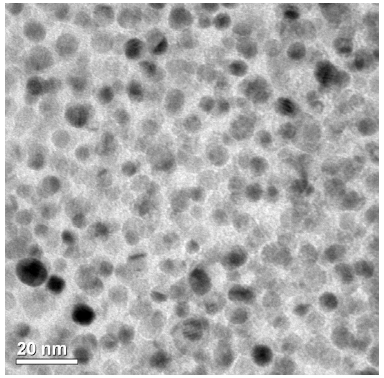

Fig. 1. FEG-TEM images of (FePt)37 - (SiNx)63 films annealed at 700 oC for 30 minutes.