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Surface Oxidation and Magnetic Properties of Fe-Si-B-Nb Amorphous Alloy

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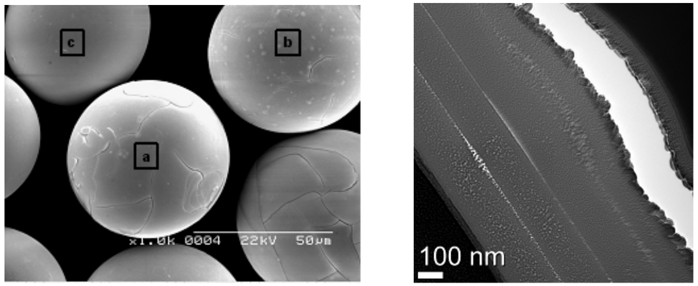
In the present work, the forming mechanism of oxide layer during wet oxidations was presented. There can be three kinds of stress sources that develop cracks in the oxide layer during oxidation. One is the volume change by oxidation, the other is thermal expansion by the heat of oxidation, and the third is the gas pressure evolved.

In this investigation, the surface oxidation mechanism of Fe – Si – B – Nb amorphous powder during wet oxidation treatment is studied by the analysis of the composition and magnetic domain of oxide layer. Fe – Si – B – Nb amorphous powder used in this research was 53-75 μm in diameter; and the morphology of oxide layers could be controlled by changing treatment time. The phase and morphology of composing insulating layer of consecutive oxide layers was characterized by SEM, XPS, EDS, FIB, TEM and Lorentz TEM.



(a) (b)

Fig. 1. SEM images of oxidized Fe-Si-B-Nb amorphous powders:(a) surface image of cracked-type powder (b) cross-slectiona image of multi-layered structure in oxide layer.

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Granular FePt−NiO Films by Rapid Thermal Annealing Technique for High Density Magnetic Recording Media

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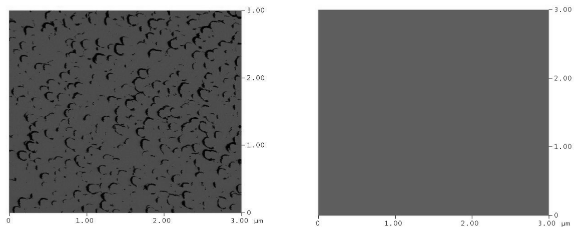
Ordered $L1_0$ FePt film with high magnetocrystalline anisotropy constant Ku (7×10^7 erg/cm^3)[1,2] is considered a potential candidate for ultrahigh density magnetic recording media due to a small critical size even about 3 nm can overcome thermal instability [3]. However, The main problems encountered in the fabrication of FePt films for high-density recording applications are the grain growth during annealing process and strong exchange coupling interaction between the L10 FePt grains. In this article, we have fabricated FePt-NiO nanocomposite films and the volume fractions of NiO (V_{NiO}) were controlled to be 0, 2.0, 4.0, 10.4, 14.4, 21.3, 33.4, and 42.0 vol.%. As-deposited FePt-NiO films were annealed at 750°C for 3min in Ar atmosphere by rapid thermal annealing (RTA) technique with a high heating ramp rate 100°C/sec.

It is found that both the in-plane and perpendicular coercivity decrease with increasing NiO content in the FePt films. By increasing the NiO volume fraction from 0% to 10.4%, the in-plane coercivity ($Hc_{//}$) decreases from 10 to 6 kOe and the ordering parameter (S) of FePt is decreased from 0.96 to 0.85. Therefore, The decrease in the coercivity is mainly due to the reduction of ordered L10 FePt hard magnetic phase as adding NiO in the FePt films. On the other hand, the grain size of FePt films is found to decrease from 26.0 to 19.9 nm when VNiO is increased from 0 to 10.4%, which indicates that the magnetic recording density can be increased by adding NiO compound into FePt films.

Conductive-AFM images of FePt-NiO nanocomposite film with different VNiO contents of 0% and 42% are shown in Fig.1 (a) and (b).Because FePt alloy is a good conductor and NiO are insulator, the gray regions are the FePt nanoparticles and the dark areas are the NiO compound. It is found that the NiO compound dispersed at grain boundary of FePt to decrease exchange coupling interaction between FePt magnetic particles, which is beneficial to reduce the media noise.



(a) (b)

Fig. 1. The Conductive-AFM images of the FePt–NiO films annealed at 750°C for 3 min with various NiO Contents (a)0 vol.% (b)42.0 vol.%.

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