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Properties of Sr Ferrite Thin Films on AlSi Underlayer

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Hexagonal ferrite is one of candidate magnetic materials for perpendicular magnetic recording. An appropriate underlayer is used to improve crystallographic and magnetic properties [1]. The phase-separated Al-Si film [2], which is composed of Al nanocylinders embedded in an amorphous-Si matrix, is expected to be used as the underlayer for the reduction of crystallization temperature, promotion of c-axis orientation of hexagonal ferrite layer and contributed to reduction of magnetic coupling betweenthe magnetic grains. The influences of substrate temperature on their crystalline and magnetic properties of SrM films are studied.

SrM/AlSi films deposited on Si(111) were prepared by a DC magnetron sputtering system. The base pressure was below 1.5×10^{-6} Torr. The sintered target with stoichiometric composition of M type ferrite is $MeFe_{12}O_{19}$ was used for the deposition of SrM film. The sputtering gas was the mixture gas of argon and oxygen with pressure of 1.98 and 0.02 mTorr, respectively. The substrate temperature, T_s, was varied in the range from 500 to 600°C. The deposition of AlSi underlayer film was performed in a pure Ar gas pressure of 2.0 mTorr. The substrate temperature of underlayer was room temperature. The crystal structure of the films was determined by x-ray diffractometer (XRD). The magnetic properties were measured by vibrating sample magnetometer (VSM).

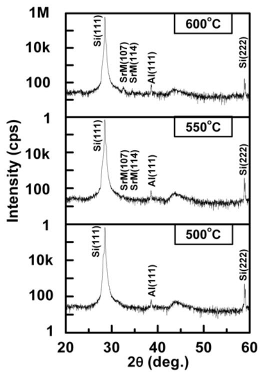

Fig. 1. XRD diagrams of the films prepared at various Ts.

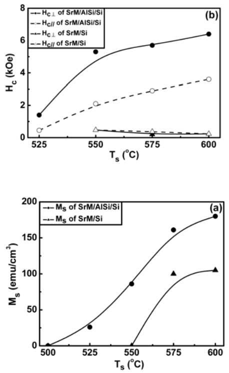

Fig. 2. Dependence of (a) Ms and (b) Hc of SrM thin films on Ts.

Figure 1 shows XRD diagrams for the SrM/AlSi films. The preferred (111) orientation of *fcc* lattice of Al can be observed for all of the films. There are no obvious diffraction line from SrM phase at T_s below 500°C and the SrM films with (107) orientation can be prepared when T_s is higher than 525°C. As shown in Fig. 2(a), the M_s increases from almost zero to 180 emu/cm^3 with increase of Ts from 500 to 600°C. The perpendicular coercivity, $H_{c\perp}$, is higher than the in-plane coercivity, $H_{c//}$ as shown in Fig. 2(b). The difference between $H_{c\perp}$ and $H_{c//}$ increase with increasing T_s and $H_{c\perp}$ reachs a maximum of 6.4 kOe at T_s=600°C. These results indicate that the perpendicular anisotropy of SrM thin film increases with the increase of T_s. On the other hand, there are no obvious diffraction line from SrM phase for SrM/Si films and both of coercivities are below 0.5 kOe at T_s below 600°C.

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CC05

Spin Reorientation of Epitaxial Nd-Fe-B Films by Mechanical Elongation

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While $Nd_2Fe_{14}B$ is already used in high performance bulk magnets, thin films are interesting for applications such as microactuators, motors and magnetic recordings. For technological applications, well textured $Nd_2Fe_{14}B$ films are available [1,2]. Nd-Fe-B has very high magnetocrystalline anisotropy, therefore, magnetoelastic anisotropy is usually neglected. However, in large external stress, especially spin reorientation transition at low temperature should be affected. Here a new approach to study the influence of huge strain on the intrinsic properties of $Nd_2Fe_{14}B$ under uniaxial stress is presented.

Hastelloy, which has high ductility, is used as substrate to reach a strain up to 4% by conventional mechanical elongation. Prior to elongation, MgO(001) had been deposited by ion beam assisted deposition(IBAD). As a next step Mo and Nd-Fe-B are deposited at 450°C by pulsed laser deposition. Mo grows epitaxially with a (001) orientation and Nd-Fe-B films onto this buffer possess the desired (00l) out-of-plane orientation.

Elongation breaks the in-plane symmetry compared to the as-deposited state, resulting in an elliptical shape of the cone opening during spin reorientation up to the strain value around 2% and in higher strain like 4%, cracking and partial delamination of the films occurred. However, temperature for the spin reorientation does not change significantly under the uniaxial strain. By this novel approaches high strains are obtained which allows examining highly anisotropic materials where magnetostriction can usually be neglected and this approach is versatile to study the influence of large strain on various materials, as the used MgO (001) layer is a common substrate for epitaxial growth.

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