Fe-O を介した 90 度磁気結合の下地依存性

The Buffer Layer Dependence of 90 degree Magnetic Coupling through Fe-O

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Recently antiferromagnetic (AFM) materials have attracted much attention owing to the high frequent dynamics and no stray field. Since it is difficult to reveal and control AFM material itself, we proposed the quasi-AFM materials, which is the middle state between ferromagnetic (FM) and AFM states. We previously reported that the quasi-AFM materials can be obtained by using the 90 deg magnetic coupling and that Fe-O with the low pinhole density realizes the 90 deg magnetic coupling because the pinhole is the origin of ferromagnetic coupling which disturbs the 90 deg magnetic coupling [1]. In this report, the buffer layer dependence of 90 deg magnetic coupling was investigated.

Ta 5/buffer layer/$Ir_{22}Mn_{78}$ 5/$Co_{90}Fe_{10}$ 2/Fe-O 2/$Co_{90}Fe_{10}$ 2/Cu 6/$Co_{90}Fe_{10}$ 2.5/Cu 1/Ta 5 (unit: nm) films were deposited on the thermal oxidized Si wafer in a dc magnetron sputtering system. We fabricated two kinds of samples (i) and (ii) with Ru (2 nm) and $(Ni_{80}Fe_{20})Cr_{40}$ (5 nm)/$Co_{90}Fe_{10}$ (1 nm) buffer layer, respectively. Since in general $(Ni_{80}Fe_{20})Cr_{40}$ buffer provides the larger grain size than Ru buffer, the pinhole density based the grain should be decreased. After depositing Fe_3O_4, the oxygen gas was introduced into the chamber and the oxygen exposure was 500 kL. To set the IrMn exchange biasing direction, the films were annealed in a field of 4.1 kOe at 270 ℃ for 1 h.

Figure 1 (a) and (b) show *MH* loops when a field is applied along the perpendicular direction to the annealing field for the film with Ru buffer and $(Ni_{80}Fe_{20})Cr_{40}$ buffer, respectively. By comparison them, it was found that the 90 deg magnetic coupling energy of the sample with $(Ni_{80}Fe_{20})Cr_{40}$ buffer is larger than that with Ru buffer. It is considered that because the roughness of the Fe-O layer should be restrained by using NiFeCr/CoFe buffer layer, we can obtain the good balance of FM and AFM coupling energies through the Fe-O film as expected.

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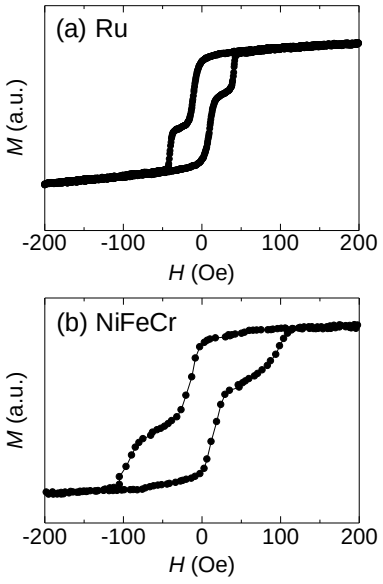

Fig. 1. (a) and (b) are *MH* loops of the samples (i) and (ii) in applied fields along 90 deg to the annealing field.

[1] “Fe-O 膜のピンホール密度と 90 度磁気結合実現の関係”, 第 65 回応用物理学会春季学術講演会 17p-P10-17