ES09

Temperature Dependence of Magnetic Properties in Single Crystal FePt/FeRh bilayer

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Recently, FePt/FeRh bilayers have attracted much attention, because of their potential application for heat assisted magnetic recording medium. It is known that ordered bcc FeRh alloys exhibit the first-order phase transition from antiferromagnetic to ferromagnetic upon heating at around 100 °C [1] and ordered FePt layer has very large perpendicular magnetic anisotropy [2]. There are a lot of effects relating to this system, such as exchange bias, and the first-order phase transition. Until now the mechanism of these effects is still unclear. Therefore the aim of the present work is to conduct a systematically study of the temperature dependence of magnetic properties in single crystal FePt/FeRh bilayer.

Bilayers FePt(50 nm)/FeRh(50 nm)/ MgO(001) were fabricated using an $Fe_{50}Rh_{50}$ and $Fe_{50}Pt_{50}$ alloy targets by sputtering at substrate temperature of 450 ^{o}C. An x-ray diffractometer and a vibrating sample magnetometer were used to characterize structure and magnetic properties of samples

2θ/ω and Φ scan of FePt(50 nm)/FeRh(50 nm) bilayer in x-ray diffraction patterns indicates that the FeRh and FePt layers are single crytal films. The temperature dependence of magnetization, coercivity and exchange bias field in both parallel and perpendicular directions were showed in figure 1. At the transition temperature, in parallel direction, the coercivity decreases shapely from 6000 Oe to 350 Oe i.e., a reduction of ~ 94%. For comparison, the temperature dependence of magnetization of single FePt(50 nm) were plotted together with FePt(50 nm)/FeRh(50 nm) bilayer. The other interest is that the coercivity of single FePt is smaller than FePt/FeRh bilayer. At the low temperature, FeRh is in antiferromagnetic state, the exchange bias effect was observed in the FePt/FeRh bilayer. The exchange bias field is very large up to 350 Oe at -196 ^{o}C. When the temperature increases, the exchange bias field decreases, and disappears at blocking temperature of about 140 ^{o}C. This temperature is nearly equal the transition temperature of FeRh. In perpendicular direction, the decrement in coercivity is not significant as compared with that of parallel case, and the exchange bias effect was not observed. Further investigation is in progress to clarify this intriguing behavior.

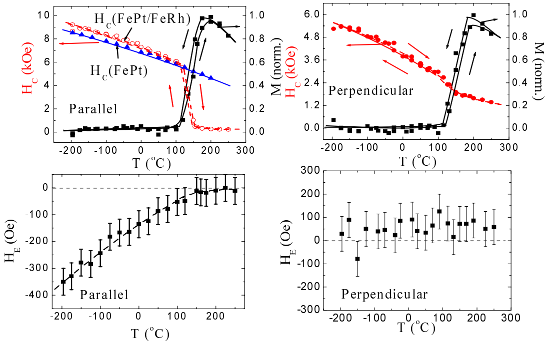

Fig. 1. Temperature dependence of magnetization, coercivity and exchange bias field of FePt(50 nm)/FeRh(50 nm)/MgO, TS = 450 ^{o}C.

[1] J. S. Kouvel., J. Appl. Phys.37, 1257(1966).
[2] T. Suzuki, H. Kanazawa, and A. Sakuma., IEEE Trans. Mag.38, 2794(2002).

ES10

Ferromagnetic Magnetization Reversal of Exchange-Biased NiFe/FeMn/CoFe Trilayers

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Magnetic trilayers consisting of two ferromagnetic layers separated by a nonmagnetic metal or insulating layer have been known to exhibit the novel quantum phenomena such as an oscillatory interlayer exchange coupling and a spin-dependent tunneling during the last decade [1]. Although several theories and experiments have been reported on a few systems so far, there has not been much attention on the magnetic trilayers intervened by an antiferromagnet [2]. Nowadays the NiFe/FeMn/CoFe trilayer has become one of the pinned electrodes which have been widely utilized for the realization of magnetic tunnel junctions and a giant magnetoresistance spin valves. 30-nm NiFe (bottom)/FeMn/30-nm CoFe (top) with varying FeMn thickness from 0-nm to 5-nm were grown on a transparent a silicon nitride substrate using a magnetron sputtering at Ar working pressure of 1.5 mTorr in a ultrahigh vacuum of 2.0×10^{-9} Torr. 5-nm Ta underlayer was inserted to induce the FeMn (111) texture and 5-nm Ta capping layer was deposited to prevent a sample surface from an oxidation. To induce the exchange anisotropy, a magnetic field of 300 Oe was applied during a sample deposition. The magnetic hysteresis (M-H) loops were measured with a vibrating sample magnetometer (VSM). Exchange bias is not observed less than 5-nm FeMn and increases proportional to FeMn layer thickness for more than 5-nm. However, it is difficult to find the static and dynamic magnetic properties of each ferromagnetic layer such as magnetic depth profile, switching field, and magnetic reversal process only from VSM-loops due to hysteresis superposition. Longitudinal and transverse magneto-optical Kerr (LT-MOKE) hysteresis loops were measured by probing front and back sides of a sample with a wavelength of 780 nm. The complementary combination of front-back LT-MOKE and VSM can give the valuable information about magnetization dynamics of each ferromagnetic layer exchange-biased by a common antiferromagnetic layer.

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[1] S. S. P. Parkin, R. Bhadra, and K. P. Roche, Phys. Rev. Lett. 66,2152(1991).
[2] Ki-Suk Lee et al, J. Magnetics 10(1), 36 (2005).