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Enhancement of coercivity due to the nonmagentic IrMn bufferlayer

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1. INTRODUCTION

In the spin valve system, the exchange-bias which occurs between feromagnetic (FM) and antiferromagnetic (AF) layers, is technically important. The IrMn is one of the widely used material as an AF due to its high Blocking temperature. It is widely accepted that the exchange bias can be exist in (111) textured IrMn layer, and the (111) texture is one of the necessary conditions for the exchange bias. Therefore the thick Cu (111) layer is usually used as a buffer layer in order to increase texture. In this study, we found that thin IrMn layer enhanced the coercivity in Ta/IrMn/FM structure, where the InMn thickness is less than 30 A. In this system, the coercivity is increased 92% compare to the Ta/FM structure, and there is no exchange bias is observed at room temperature. It is believed that the IrMn is not an AFM in this thickness range at room temperature. Therefore, we believe that the origin of the coercivity increasement is microstructural changes and not an exchange bias. So this phenomenon is useful for CIMS (Current Induced Magnetotransport) applications due to the non-magnetic nature of the thin IrMn layer.

2. EXPERIMENT

The structure samples were fabricated by using an Ultra High Vacuum (UHV) DC magnetron sputtering system with two chambers and a load-lock system. We used SiO_2 substrates that were consist of Si(100Å)/SiO_2(1500Å). Every substrates cut 11.8 mm × 11.8 mm by the dicing saw. All samples were deposited in a high vacuum of 10^{-9} Torr. The basic structures of samples were Ta/IrMn/CoFe/Ta. All materials were deposited using DC power that was varied from 30W to 50W. The working pressure was varied from 1 mTorr to 7 mTorr and Ar ratio was varied from 15 sccm to 25 sccm. A magnetic field of 100±5 Oe was applied during the sputtering in order to induce easy direction of magnetization in all material layers.

3. RESULTS AND DISCUSSION

Fig. 1. shows the magnetic properties of both Ta(50Å)/CoFe(60)/Ta(50) and Ta(50Å)

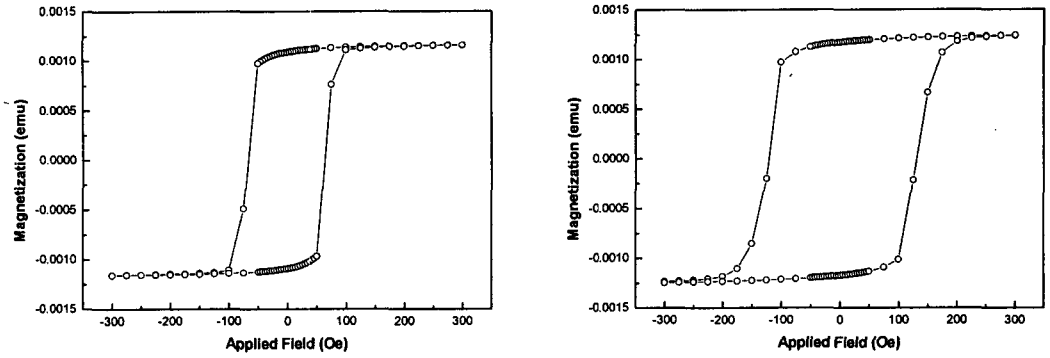

Fig. 1. The properties of magnetization with Ta(50Å)/CoFe(60)/Ta(50) and Ta(50Å)/IrMn(30)/CoFe(60)/Ta(50).

/IrMn(30)/CoFe(60)/Ta(50). As shown in Fig. 1, the coercivity of sample I and sample II were 65 Oe and 125 Oe, respectively. Therefore, the structure of sample II enhanced the coercivity of FM layer.

In general, the FM layer which is contact with a certain AF layer show a shift in the magnetization curves away from zero field axis which is commonly referred as an exchange bias effect. This phenomenon is naturally thought to be a consequence of an exchange coupling between AF and FM, so called exchange bias. There are some finger print about the exchange bias. The enhancement of coercivity, increasing exchange bias and thickness dependence of AF.

As shown in Fig. 1, the IrMn layer did not induce any exchange-bias effect on CoFe layer, but make an enhancement of the coercivity. The origin of these phenomena will be explained by magnetocrystalline anisotropy mechanisms.

4. ACKNOWLEDGMENT

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5. REFERENCES

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