Perpendicular Magnetic Anisotropy in Amorphous Ferromagnetic CoSiB/Pd Multilayer with Various Thicknesses

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1. Introduction

Perpendicular magnetic anisotropy (PMA) is the phenomenon of a magnetic thin film which is preferentially magnetized perpendicular to the film plane. This phenomenon was first observed in thin films of Co/Cr alloys in 1975 and is currently of interest in relation to high-density magnetic recording. In the search for other various candidates for recording media, multilayers offer the possibility for anisotropy dominated by the existence of interface anisotropy. PMA has been studied as a possible candidate for a high-density spin transfer torque magnetic random access memory [1-5]. Magnetic multilayer which includes metal alloys based on Co/Pt or Co/Pd, has been investigated because exchange coupled super lattice films of alternating ferromagnetic and non-magnetic layers can be engineering to show strong PMA [6-8]. Some materials show better interface roughness than crystalline materials, one of these materials being the amorphous metal alloy CoSiB. The amorphous magnetic materials like CoSiB are required for high-density magnetic devices and CoSiB alloy is expected to be a potential candidate material for the free layer in a high-density MRAM.

2. Experiments

The chamber's base pressure was up to 2.0×10^{-7} Torr, and the working pressure was 2×10^{-3} Torr after flowing Ar gas (46sccm). All thin films were uniform in size, 1.4cm x 1.4 cm, and were deposited at room temperature. The magnetic properties of the thin films were measured by a vibrating sample magnetometer.

3. Result

All of the results in this study, we present by Fig. 1. The [CoSiB 3 Å/Pd 13 Å]$_5$ multilayer shows perpendicular magnetic anisotropy better than the others.

4. Discussion

In this letter, we vary present the graphs of all samples; detailed data and the reason for these results will be presented in our next letter. We will demonstrate the amorphous CoSiB/Pd multilayer system to be beneficial for applications of magnetic tunnel junctions and interactions between CoSiB and Pd in a next study.

5. Conclusion

We conclude that PMA depends on the CoSiB thickness more than it does on the Pd thickness because the PMA is influenced by the ferromagnetic material's thickness. In addition, the squareness depends on the repetition time of the bilayer (FM/AFM).

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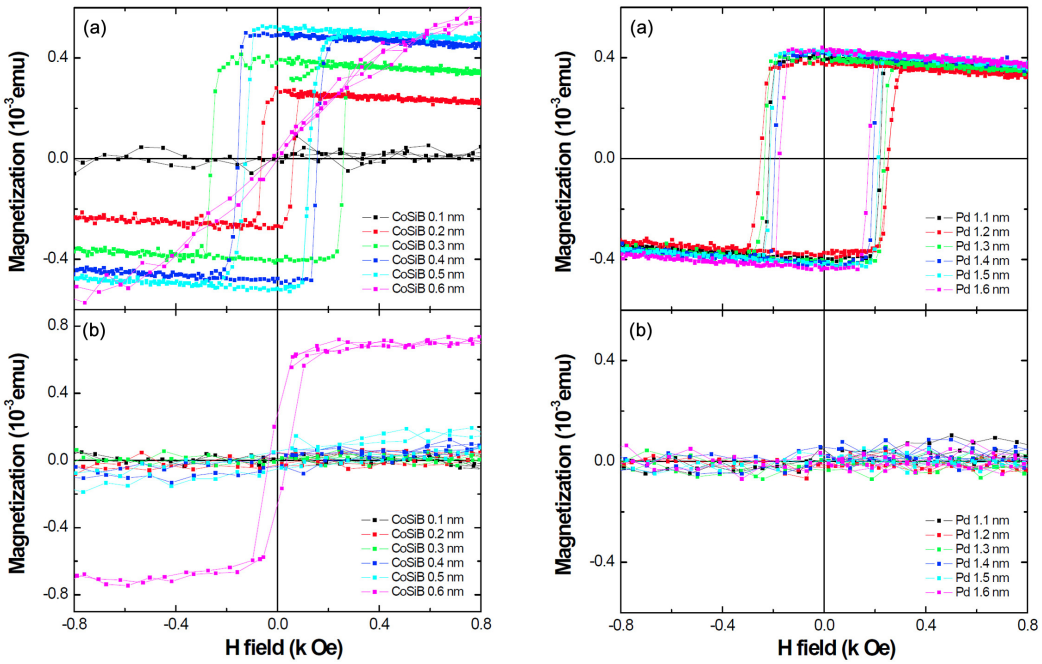

Figure 1. The hysteresis loops of the [CoSiB t_{CoSiB} nm/Pd tPd nm]5 multilayer, which t_{CoSiB} are 0.1 ~ 0.6nm and t_{Pd} are 1.1 ~ 1.6 nm: (a) Out-of-plane, (b) In-plane.