Thickness Dependence of saturation magnetization in amorphous CoSiB multilayers

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1. Introduction

Magnetic multilayers with perpendicular magnetic anisotropy are one of the most attractive systems for the next-generation device applications such as high-density data storage and spin-transfer torque magnetic random access memories [1-3]. Perpendicular magnetic anisotropy is the phenomenon of a magnetic multilayer that is preferentially magnetized in a direction perpendicular to the film's surface. Perpendicular magnetic anisotropy was suggested and investigated in 1975 and was first observed in Co/Cr films [4]. It has been established to the importance of interfaces as the driving mechanism for Perpendicular magnetic anisotropy in the multilayers [5].

For applications to high-density devices, magnetic multilayers with perpendicular magnetic anisotropy must have a large magnetic anisotropy (K_u) and a low saturation magnetization (M_s) [2, 6]. Therefore, multilayers with PMA consist of ferromagnetic materials and non-magnetic materials have been studied for reducing M_s and enhancing K_u. Moreover, a multilayer with PMA must have a large coercivity (H_c) because of the demagnetizing field. The demagnetizing field increases with decreasing thickness of the ferromagnetic layer for the same width and height [7]. In this study, we investigated M_s and H_c of CoSiB/Pd multilayer with various Pd-layer's thickness. We note the dependence of the M_s and H_c of Pd-layer thickness in CoSiB/Pd multilayer.

2. Experiment

The chamber's base pressure was up to 2.0×10^{-7} Torr, and the working pressure was 2×10^{-3} Torr. All films were uniformed in size, 1.4 cm × 1.4 cm, and were deposited by ultra high-vacuum system at room temperature. The magnetic properties (M_s and H_c) of all thin-films were measured by a vibrating sample magnetometer.

3. Result and discussion

We investigated the PMA and the Hall effect of [CoSiB (7 Å)/Pd (t_{Pd})]$_5$ multilayers with various thicknesses of the Pd layer. We found the dependences of M_s and H_c on the thickness of the Pd layer. In the [CoSiB (7 Å)/Pd (20 Å)]$_5$ multilayer, the maximum value of H_c and the minimum value of M_s were measured as 195.9 Oe and 631.2 emu/cm^3, respectively. We will show the multilayer including CoSiB and interpret the correlation between magnetization and the Pd-layer thickness in the conference.

4. Reference

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