Investigation of composition dependence on the exchange anisotropy in PtxMn1-x/Co70Fe30 Films

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Exchange bias (EB) can be observed by the exchange coupling between the magnetic moments of an antiferromagnet (AFM) and those of a ferromagnet (FM) at an AFM/FM interface [1,2]. There are many reasons to choose AFM materials for instances: the large exchange-biasing field, the high blocking temperature at which the exchange-biasing disappears, good corrosion resistance, minimal critical thickness, and surface flatness [3,4]. In this study we systematically investigated the exchange anisotropy for ferromagnetic $Co_{70}Fe_{30}$ and antiferromagnetic Pt-Mn bilayer films by Co-sputtering method. We focused on the relevance between the exchange bias and the composition of the Pt_xMn_{1-x} ($14 < x < 22$ and $45 < x < 56$ at %) films, and we successfully optimized the composition. The crystal structure of the Pt_xMn_{1-x} films was FCC for $14 < x < 22$ at % and FCT for $45 < x < 56$ at % after annealing at 370 ℃ for 6 hours. The unidirectional anisotropy constant (J_k) for fcc-$Pt_{15}Mn_{85}$ (20 nm) and fct-$Pt_{48}Mn_{52}$ (20 nm) prepared under optimum conditions in composition were 0.16 and 0.20 erg/cm^2, respectively. In addition, to optimize the annealing temperature of the respective optimum compositions ($Pt_{48}Mn_{52}$, $Pt_{15}Mn_{85}$), we need to investigate the changes of J_k value as a function of annealing temperature. Both $Pt_{15}Mn_{85}$ and $Pt_{48}Mn_{52}$ films showed a larger unidirectional anisotropy constant (J_k) than in other reports for the bilayer system that uses Pt-Mn antiferromagnetic layer. They also showed a flatter surface than that of other antiferromagnetic/ferromagnetic materials, which is suitable to avoid unexpected interlayer coupling in spin-valve structure. The obtained Pt-Mn films with a large exchange anisotropy and slight roughness are useful as an antiferromagnetic layer in spintronic applications.

Key words: antiferromagnetic material, PtMn thin film, exchange anisotropy

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