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Co/Pt 다층박막에서의 활성화부피의 정량적 측정

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Quantitative determination of activation volumes from field dependence of magnetization reversal behavior in Co/Pt multilayers

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1. Introduction

Co/Pt multiplayer system has been one of the most promising materials for perpendicular magnetic recording and magneto-optical recording media, due to their large perpendicular magnetic anisotropy as well as their large Kerr rotation angle. The determination of activation volume is crucial in magnetic recording media since it affects the media noise and thermal stability and also, provides information on minimum size of domain. In this paper, we determined the activation volumes of the wall-motion and the nucleation processes in Co/Pt multilayers via a direct domain observation together with the viscous activation volume determined by a magnetic viscosity measurement.

2. Experiment

Serial samples of Co/Pt multilayers $(t_{Co}$-Å Co/11-Å$)_{10}$ with varying Co-sublayer thickness t_{Co}, were prepared by dc magnetron sputtering under Ar pressure of 7.5 mTorr. Magnetization reversal was monitored by a magnetization viscosity measurement and a direct domain observation using a magneto-optical microscope system. The viscous activation volume was calculated from field dependence of half reversal time, needed to reverse half of the area of sample under a given field. The wall-motion speed and the nucleation rate were simultaneously determined using a domain reversal model[1] based on time-resolved domain evolution patterns. In Fig. 1, we plot (a) the wall-motion speed V and (b) the nucleation rate R with respect to the reversing field for (4.0-Å Co/11-Å Pt)$_{10}$ sample. From field dependence of the wall-motion speed and the nucleation rate, we determined the wall-motion activation volume and the nucleation activation volume within the context of a thermally activated relaxation process.

3. Results and discussion

The values of activation volumes in Co/Pt multilayers, listed in Table I, were found to range from 6.3×10^{-18} to

1.4×10^{-17} cm^3 with varying the Co sublayer thickness. The viscous activation volume V_V was revealed to lie between the wall-motion activation volume V_W and the nucleation activation volume V_N. It can be understood that the viscous activation volume is considered as the effective or average value of the wall-motion activation volume and the nucleation activation volume[2]. We found that the wall-motion activation volume was slightly larger than the nucleation one and the difference in two activation volumes was closely related to reversal behavior in Co/Pt multilayes[3].

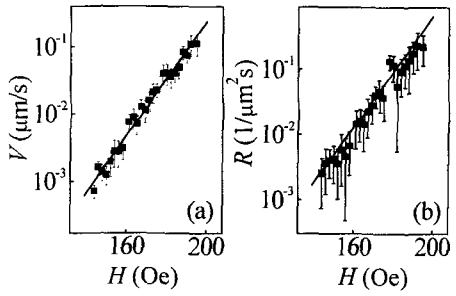

Fig.1 (a) The wall-motion speed V and (b) the nucleation rate R with respect to the reversing field H for the (4-Å Co/11-Å Pt)$_{10}$ sample prepared at A pressure of 7.5 mTorr.

Table I. The wall-motion activation volume V_W, the nucleation activation volume V_N, and the viscous activation volume V_V in Co/Pt multilayers (t_{Co}-Å Co/11-Å Pt)$_{10}$ sample prepared at Ar pressure of 7.5 mTorr

t_{Co} (Å)	V_W (10^{-18} cm^3)	V_N (10^{-18} cm^3)	V_V (10^{-18} cm^3)
3.0	13.6 ± 0.4	12.8 ± 0.5	13.1 ± 0.5
3.5	10.7 ± 0.4	9.9 ± 0.5	10.3 ± 0.3
4.0	6.6 ± 0.2	6.3 ± 0.3	6.4 ± 0.3

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4. References

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