Antiferromagnetic anisotropy of buffered Cr\textsubscript{2}O\textsubscript{3} thin films
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Magnetization reversal using Magneto-electric (ME) effect and perpendicular exchange bias (PEB) in antiferromagnetic (AF) Cr\textsubscript{2}O\textsubscript{3} has been established. For switching the PEB at low voltage, thin Cr\textsubscript{2}O\textsubscript{3} is required. But with decreasing thickness, blocking temperature (T\textsubscript{B}) of PEB in thin Cr\textsubscript{2}O\textsubscript{3} decreases due to the product of AF anisotropy and thickness (K\textsubscript{AF}*t\textsubscript{AF}) become smaller than exchange coupling energy J\textsubscript{K} = H\textsubscript{ex}M\textsubscript{s}t\textsubscript{FM}. Previously we have reported the enhancement of T\textsubscript{B} of Cr\textsubscript{2}O\textsubscript{3} film by inducing lattice strain through different buffer layers. T\textsubscript{B} of 20nm thick Cr\textsubscript{2}O\textsubscript{3} film with Fe\textsubscript{2}O\textsubscript{3} buffer layer modulation of K\textsubscript{AF}. In this study, we evaluate the K\textsubscript{AF} of Cr\textsubscript{2}O\textsubscript{3} layers with different buffers, based on Meiklejohn-Bean’s exchange anisotropy model [1].

Sample design is c-Al\textsubscript{2}O\textsubscript{3} sub./Pt 25 or α-Fe\textsubscript{2}O\textsubscript{3} 20/Cr\textsubscript{2}O\textsubscript{3} t\textsubscript{Cr2O3}/Ru t\textsubscript{Ru}/Co 1/Pt 5 (nm). Samples are fabricated by using a RF/DC magnetron sputtering. Ru spacer layer thickness t\textsubscript{Ru} was varied from 0 to 1.25 nm. Structural characterization is performed by XRD and TEM. Magnetic properties are measured by SQUID magnetometer after field cool from 340 K to 10 K with magnetic field of +1 T.

We fabricated samples with different t\textsubscript{Ru}, i.e. samples with different J\textsubscript{K}. Using these samples we decided the critical J\textsubscript{K}(J_{Kc}) where the H\textsubscript{ex} disappears. Then we evaluated the K\textsubscript{AF} of Cr\textsubscript{2}O\textsubscript{3} films assuming the relationship J_{Kc} = K_{AF}t_{AF}. Figure 1 shows the temperature dependence of K\textsubscript{AF} of 20nm thick Cr\textsubscript{2}O\textsubscript{3} film with different buffer layers evaluated using above mentioned relationship. The K\textsubscript{AF} are ~ 10\textsuperscript{5} erg/cc at 50 K, which is same orders of magnitude with previous report [2]. Cr\textsubscript{2}O\textsubscript{3} film with α-Fe\textsubscript{2}O\textsubscript{3} buffer layer exhibit 2~3 times larger K\textsubscript{AF} compared with those with Pt buffer layer. The change in K\textsubscript{AF} is due to the lattice distortions of Cr\textsubscript{2}O\textsubscript{3} induced by buffer layers. We confirmed the buffer layer effect on K\textsubscript{AF}.

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References

![Fig. 1 Temperature dependence of K\textsubscript{AF} of 20nm thick Cr\textsubscript{2}O\textsubscript{3} film with α-Fe\textsubscript{2}O\textsubscript{3} buffer (red circles) and that with Pt buffer (black squires)](image)