Lattice distortion of $L1_0$-MnGa ultrathin films grown on CoGa templates

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Magnetoresistive random access memory (MRAM) attracted much attention as a next-generation nonvolatile memory. It is expected to utilize $L1_0$-MnGa thin films to magnetic tunnel junctions for MRAM with high recording density because those show small magnetization and high perpendicular magnetic anisotropy (PMA) [1]. Recently it was reported that the 1-3-nm-thick MnGa films with a lattice distortion can be grown at room temperature on a *B2* ordered paramagnetic CoGa buffer layer [2]. However, the correlation between the lattice distortion and magnetic properties is not clear. Here we report the quantitative evaluation of the lattice distortion and its correlation with PMA properties.

The samples of MgO subst./ Cr(40)/ CoGa(30) /MnGa (t_{MnGa}) /CoGa(3) (thickness is in nm) . Film surface was characterized using reflection high-energy electron diffraction (RHEED), and the film structures were also evaluated by X-ray diffraction (XRD). Polar magneto-optical Kerr effect (p-MOKE) measurements were carried out for characterizing magnetic properties.

The in-plane (*a*) and out-of-plane (*c*) lattice constants of the MnGa layer were obtained by RHEED and XRD, respectively. Figure 1 shows the values for the axial ratio (*c*/*a*) evaluated as a function of the MnGa thickness. Large decrease in the *c*/*a* values with decreasing the thickness was clearly observed. The thickness dependence of the coercivity (H_c) obtained from the p-MOKE is shown in Fig. 2. The thickness dependence of H_c was similar to that of the *c*/*a* value, indicating the deterioration of PMA due to the lattice distortion.

This work was partially supported by ImPACT and KAHENHI (17K14103).

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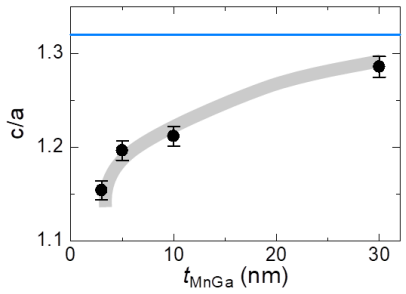

Fig. 2 MnGa thickness dependence of *c*/*a*. Line is the reported value [2].

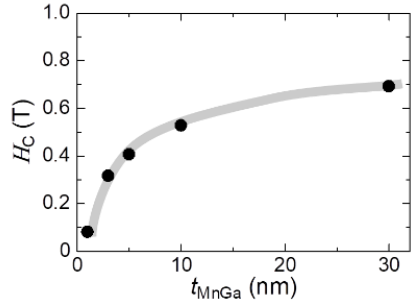

Fig. 3 MnGa film thickness dependence of *H*c.