



MnGa polycrystalline ultrathin films with perpendicular magnetic anisotropy prepared on thermally-oxidized Si substrate

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Tetragonal MnGa alloy is one of the most intensively studied materials due to its high perpendicular magnetic anisotropy (PMA), high spin polarization, and low Gilbert damping constant [1]. Recently we have reported that ultrathin MnGa films deposited on the CoGa buffer layer showed perpendicular magnetization even when the film thickness was as thin as 1 nm [2]. These MnGa films have been prepared on MgO single crystalline substrates, which have a limited scope of practical applications. Polycrystalline textured films are desired because of their compatibility with practical industrial applications. Here we investigate the structure and magnetic properties of polycrystalline MnGa films on a CoGa buffer layer prepared on thermally-oxidized Si substrate.

The stacking structures of Si / SiO₂ substrate / MgO(10) / Cr(40) / CoGa(30) / MnGa($t_{\text{MnGa}}=1-30$ nm) / Mg(0.4) / MgO(5) / Ta(3) (thickness is in nm) were prepared using a magnetron sputtering. Figure 1 shows the 2 θ - θ profiles of X-ray diffraction (XRD) for the MnGa films. Only (002) peaks of the MnGa films with different thicknesses was occurred, indicating that the (001)-textured MnGa films was crystallized. Figure 2 shows a hysteresis loop for the out-of-plane polar magneto-optical Kerr effect (PMOKE) for the polycrystalline 3-nm-thick MnGa film. The well-squared out-of-plane hysteresis loop are observed, comparable to those for the epitaxial ultrathin films. The saturation magnetization and PMA energy of the 3-nm-thick MnGa film were evaluated to be about 200 emu/cm³ and 3 Merg/cm³, respectively, which measured using vibrating sample magnetometer (VSM). This is the first demonstration of highly textured MnGa ultrathin films with a large PMA.

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- [2] K. Z. Suzuki *et al.*, Jpn. J. Appl. Phys. 55, 010305 (2016).
- [3] A. Ono *et al.*, submitted 2016.

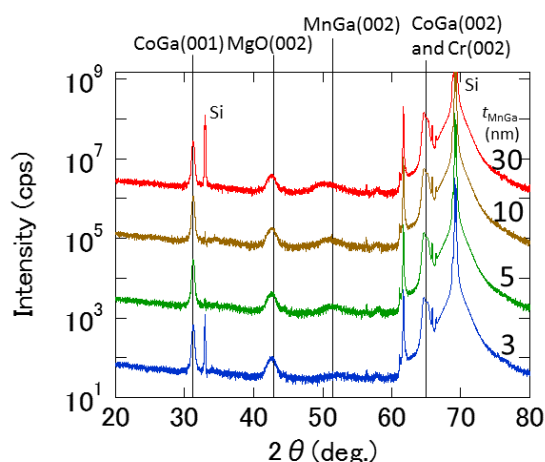


Figure 1: The 2 θ - θ profiles of XRD pattern with different thickness of MnGa films.

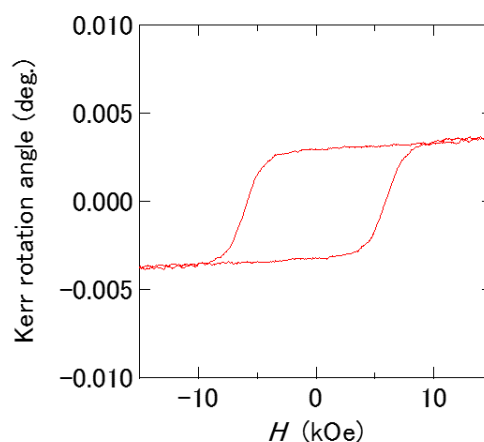


Figure 2: The hysteresis loop for the out-of-plane PMOKE with a 3-nm-thick MnGa film.