Growth of ultrathin ordered Mn-Ga films at room temperature

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$L1_0$ Mn-Ga alloy film is thermodynamically stable and shows a large perpendicular magnetic anisotropy and small damping constant [1]. These properties are attractive for nano-spintronic devices, such as gigabits class STT-MRAM and spin-torque oscillators (STO) with very high oscillation frequency. However, ultrathin MnGa films (< 5 nm) required to the STT-operation is difficult to grow on the conventional buffer layer [2-5]. Here we demonstrate the growth of ultrathin MnGa films with thickness down to 1 nm by using paramagnetic CoGa buffer layer having CsCl-type crystal structure and small lattice mismatch with Mn-Ga. All the samples were prepared by a UHV magnetron sputtering system. The sample stacking structure is MgO(001) substrate/Cr (40 nm)/ CoGa (30 nm)/MnGa (t_{MnGa}=1-5)/Mg (0.4) /MgO (5). The Cr and CoGa buffer layers were deposited at room temperature and subsequently annealed at 700 and 500 °C, respectively. The MnGa layer was deposited on the CoGa buffer layer at room temperature and not annealed. Figure 1 shows the XRD profiles for the samples. The XRD profiles for the t_{MnGa} =3 and 5 nm films show broad MnGa (001) and (002) peaks. The out-of-plane polar Kerr loops for these films are shown in Fig. 2. The loops with squareness close to unity are observed even at t_{MnGa}= 1 nm. These results indicate that the CoGa buffer layer is a promising candidate for growth of ultrathin film of Mn-based alloys [6]. This work was supported in part by NEDO and the Asahi Glass Foundation.

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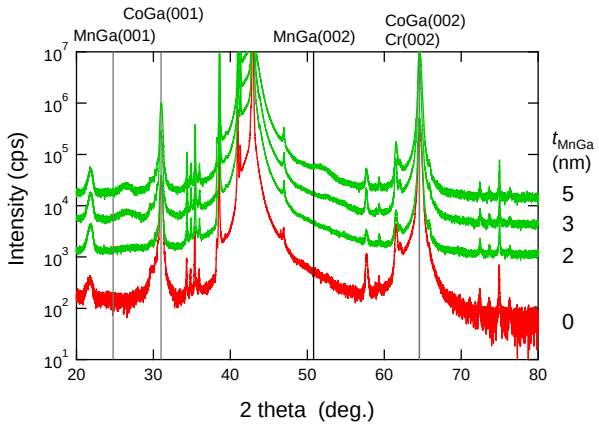

Fig.1 XRD profiles for MnGa films of different thicknesses.

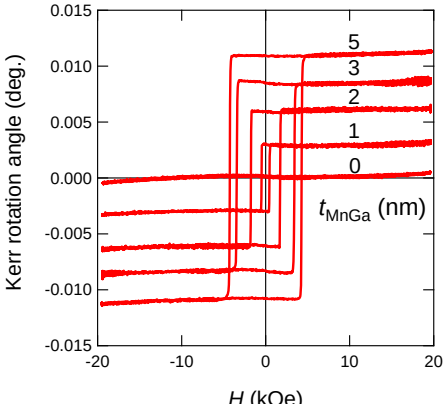

Fig.2 Out-of-plane hysteresis curves measured by polar magneto-optical