Perpendicular magnetic anisotropy in $Mn_{2-\delta}CoGa_{1+\delta}$ films

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Half metals which have perfect spin-polarization of electrons at the Fermi level is one of the promising materials for improving spintronics devices. Mn_2CoGa is an inverse Heusler alloy showing half-metallic electronic structure[1]. One of interesting physical properties for Mn_2CoGa is a relatively high resistivity[2] compared with those of Co-based half-metallic full Heusler alloys which have been applied for current perpendicular to plane giant magnetoresistance (CPP-GMR) devices to date[3].

It was also reported that magnetic anisotropy of Mn_2CoGa films depended on the buffer layer material[2]. Although the control of anisotropy is important for half-metallic materials, the key factor for manipulating the anisotropy is still unclear. In this work, we have investigated the relationship between crystal structure and magnetic anisotropy of Mn_2CoGa films with several buffer layer materials and the layer thicknesses.

The samples were deposited onto single crystal MgO(100) substrates by using an ultrahigh vacuum magnetron sputtering machine. We adopted two materials for the buffer layer; Cr or Ag. The stacking structures are as follows:

Cr buffer samples: MgO sub. / Cr (20 nm)/ Mn-Co-Ga (t)/ Ta (3 nm)

Ag buffer samples: MgO sub. / Cr (20 nm)/ Ag (40 nm)/ Mn-Co-Ga (t)/ Ta (3 nm)

The stoichiometric ratio is $Mn_{1.7}Co_{1.0}Ga_{1.3}$ for the Mn-Co-Ga layer. Mn-Co-Ga thicknesses (t) are 5 nm, 10 nm, 20 nm and 30 nm.

Crystal structures and magnetic properties were investigated by using x-ray diffractometer (XRD) and vibrating sample magnetometer (VSM), respectively.

Perpendicular magnetized Mn-Co-Ga films were achieved for the Cr buffer samples, but on the other hand, those onto Ag buffer showed in-plane magnetization.

The in-plane and out-of-plane lattice constants, a and c, were evaluated from diffraction peaks by XRD measurements. The c/a ratio was greater than 1 for the Cr buffer samples, and that was nearly 1 for the Ag buffer samples. The XRD results suggest that the perpendicular magnetization of the Mn-Co-Ga on Cr buffer originates from the tetragonal strain.

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References

[1] S. Chadov *et al*., Adv. Funct. Mater. **23**, 832 (2013)

[2] T. Kubota *et al*., J. Appl. Phys. **113**, 17C723 (2013)

[3] Y. Sakuraba *et al*., Phys. Rev. B **82**, 094444 (2010)