多結晶 MnAlGe 薄膜の磁気特性：膜厚・隣接層依存性

Magnetic Properties of Poly-crystalline MnAlGe Films: Layer Thickness and Adjacent Layer Dependence

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MnAlGe is an intermetallic compound showing the Cu_2Sb-type crystal structure and uniaxial magetocrystalline anisotropy [1]. Recent studies presented that MnAlGe films exhibited (001)-orientation onto amorphous SiO_2 surface and perpendicular magnetization [2,3]. The relatively small saturation magnetization (~ 300 emu/cm^3) and the perpendicular magnetization are attractive for spintronic application. The previous studies reported magnetic properties for thick (~ 100 nm) film samples, which should be reduced from an application point of view. In this study, the layer thickness dependence of the magnetic properties and crystal structure was investigated for the MnAlGe films. For the optimization of the relatively thin-layer thickness samples adjacent layers, buffer and capping layers, effects were also investigated. Film samples were fabricated using an ultra-high vacuum magnetron sputtering machine onto thermally oxidized silicon substrates. The stacking structure was as follows: Sub. | buffer layer | MnAlGe *t* | MgO 2 nm | Ta 5 nm. For the buffer layer, no buffer for which SiO_2 surface of the substrate acted as a buffer layer, and Ta 3 nm | MgO 2 nm were used. The layer thicknesses for MnAlGe layer, *t*, were 5, 10, and 20 nm. The film composition of MnAlGe was $Mn_{0.98}Al_{1.02}Ge_{1.00}$. All samples were annealed at 300 °C using a vacuum furnace after the capping. Magnetization curves were measured using vibrating sample magnetometer at room temperature.

In the magnetization curves measurements, all samples exhibited perpendicular magnetization for t = 10 and 20 nm. On the other hands for t = 5 nm, no hysteresis was observed for the no buffer sample, while perpendicular magnetization was clearly observed in the MgO buffer sample as shown in Fig. 1. Crystal structures, capping layer effects, and annealing temperature dependence will be also discussed in the presentation.

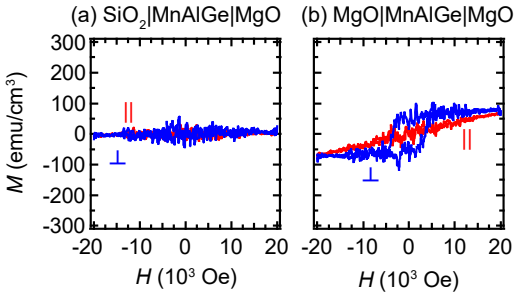

Fig. 1 Magnetization curves of 5-nm-thick MnAlGe films for perpendicular -to-plane (⊥) and in-plane (||) directions. Buffer layers are (a) SiO_2 (no buffer) and (b) MgO.

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[2] T. Kubota *et al*., APEX **12**, 103002 (2019).
[3] T. Kubota *et al*., AIP Adv. **10**, 015122 (2020).