多結晶 YIG 薄膜上におけるスパッタによる FeRh 薄膜成長

FeRh film growth on polycrystalline Y3Fe5O12 film by using sputtering

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It has been reported that the FeRh alloy undergoes a phase transition from antiferromagnetic to ferromagnetic around room temperature [1], from which we expect the spin current phenomena enhancement in the sample with conventional magnetic layer YIG, heavy metal layer Pt, and as well as FeRh film. Although FeRh film generally is formed on a single crystal such as an MgO substrate [2], we need to grow FeRh on a polycrystalline YIG to obtain a spin current. We prepared two kinds of samples on thermally oxidized Si wafer; (1) YIG 50nm / FeRh 50nm / MgO 10nm, (2) FeRh 50nm. YIG was grown by RF sputtering and annealed at 750℃ in air to obtain a garnet-structured ferrimagnet. After that, FeRh was co-sputtered on the YIG. Sample (2) was fabricated for comparison between properties of FeRh on SiO_2 and YIG. In order to obtain the ordered CsCl type FeRh, the film were annealed in a vacuum (3.0×10^{-6} torr) at two different temperatures of 750℃ and 500℃ for 1 hour.

Fig.1 shows the profiles of Grain Incidence X-Ray Diffraction (GXRD). The sample (1) on YIG apparently shows the ordered FeRh (CsCl type) peaks, while sample (2) on SiO_2 shows also unordered FeRh (fcc) peak, which suggests that ordering more easily proceeds on the garnet-structured YIG than amorphous SiO_2. However, the YIG peaks has disappeared after annealing at 750℃. This is presumably because atoms in the YIG can move and the garnet structure collapsed during annealing 750℃. In order to maintain the YIG crystal, we decreased the annealing temperature to 500℃. As a result, the ordered FeRh (CsCl type) and the YIG crystal were obtained simultaneously.

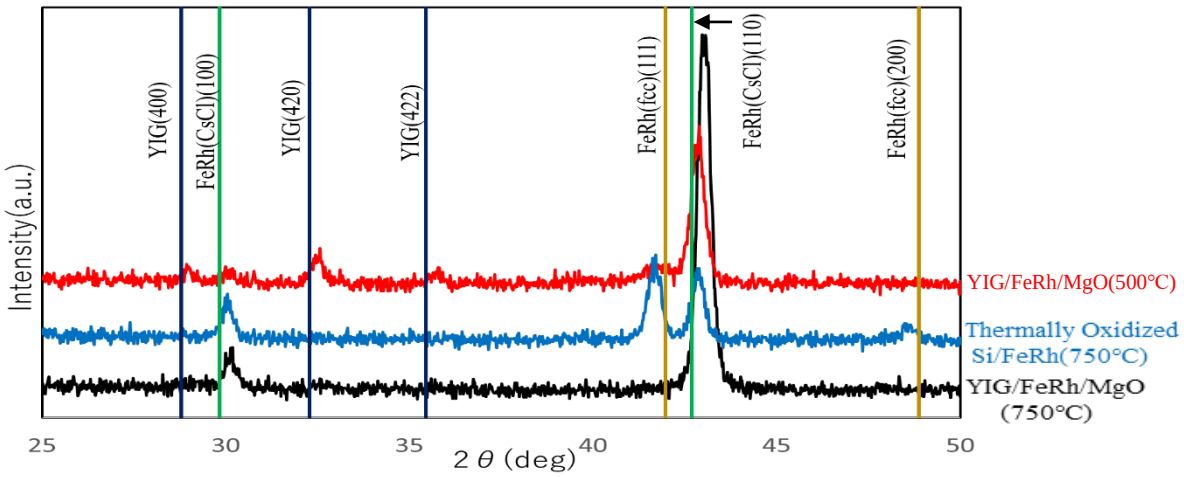

Fig.1 GXRD profiles

[1] J. S. Kouvel and C. C. Hartelius, J. Appl. Phys., 33 (1962) 1343. [2]Phys.Rev.b 72, 214432 (2005)