Fabrication of X_3Sn (X=Fe, Mn) epitaxial films and the magnetic and electronic properties

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Introduction

Transition metal - tin alloys have been paid attention as materials for spintronics devices in recent years. For example, $D0_{19}$ Mn_3Sn which is frustrated antiferromagnetic material was reported to exhibit large anomalous Hall effect because of its Berry curvature of Weyl points[1]. On the other hand, Fe_3Sn_2 and Fe_3Sn were expected to show intrinsic anomalous Hall effect which is useful for Hall sensor[2,3]. For the applications, high-quality epitaxial growth of these materials is indispensable, however it has not been achieved yet. In this work, we fabricated $D0_{19}$ type Fe_3Sn and Mn_3Sn epitaxial films and measured their physical properties. In addition, we compared magneto-transport properties of $D0_{19}$ and B2 Fe_3Sn which we developed recently[4].

Experiment

The samples were prepared by Molecular Beam Epitaxy (MBE) method. Stacking structures were as follows: Al_2O_3 (0001) substrate / Pt 6nm / Fe_3Sn or Mn_3Sn 30 nm/ Al_2O_3 5nm. Temperature of substrates during the depositions were 400℃ and 300℃ for Fe_3Sn and Mn_3Sn, respectively.

Results

Figure 1 shows RHEED pattern for the Mn_3Sn film, which is clear streak pattern indicating epitaxial growth. We also confirmed the epitaxial growth of the films by XRD. With regard to Hall effect, B2 and $D0_{19}$ Fe_3Sn exhibited clear Hall effect as shown in Fig.2. The Hall resistivity of B2 was 7 times larger than that of $D0_{19}$ Fe_3Sn. On the contrary, Mn_3Sn films did not showed Hall resistivity. These small Hall effect for $D0_{19}$ alloy could be attributed to the anisotropic crystal structure[1].

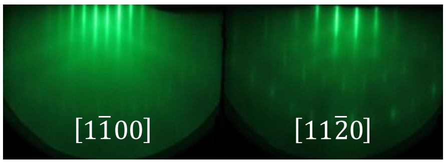

Fig.1 RHEED pattern of Mn_3Sn.

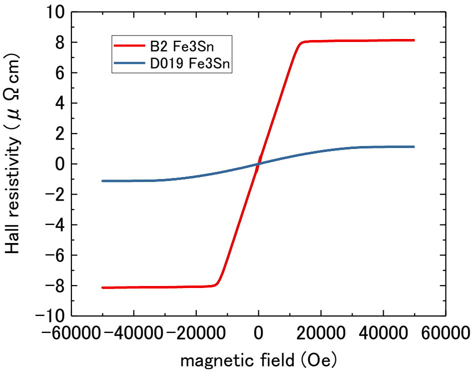

Fig.2 Hall resistivity of B2 and $D0_{19}$ Fe_3Sn.

References

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