Fabrication of Fe-Cr-Sn Heusler alloy epitaxial films

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Introduction

Heusler alloys are group of materials expected to be half-metallic ferromagnets with high Currie temperature, thermoelectric materials, and high-performance materials. For example, Co_2MnGa is well-known as high functional materials with high spin polarization. For Fe-based Heusler alloy, Fe_2CrSi is reported to be half-metallic ferromagnets, theoretically, although the alloy has not been investigated in detail experimentally[1]. Furthermore, Fe_3Sn and Fe_3Al with $D0_3$-type, which structure is very similar to Heusler, attracted much attentions due to large ANE and AHE[2, 3]. In this work, we fabricated Heusler-type alloy films using Fe and Cr (3d transition metals), and Sn (group 14 elements), and investigated the magnetic and transport properties.

Experiment

The samples were fabricated by Molecular Beam Epitaxy (MBE) method. Stacking structures were as follows: MgO (001) substrate/ MgO 20 nm/ Cr 20 nm/$Fe_{3-x}Cr_xSn$ (FCS) 30 nm/ Al_2O_3 2 nm. The crystallographic structures were identified by reflection high energy electron diffraction (RHEED) and X-ray diffraction (XRD), magnetic properties were measured by MPMS and the electronic measurements were carried out in a cryostat.

Result

Figure 1 shows RHEED of FCS films, which is clear streak pattern indicating high flatness films by MBE method. Figure2 shows XRD profiles of the samples with x=0.3, 0.5, 0.7, 1.0. The two peaks were observed near 60 degree, the low angle peak is the FCS (002) peak and the high angle peak is the Cr buffer layer. The peak near 30 degree is superlattice peak FCS (001). These results indicate that B2-type FCS were fabricated by MBE method.

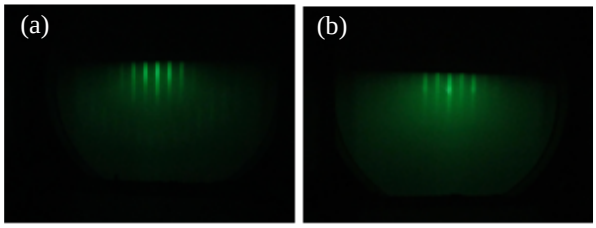

Fig.1 (110) RHEED of (a) FCS(x=0.3), (b)FCS(x=0.5)

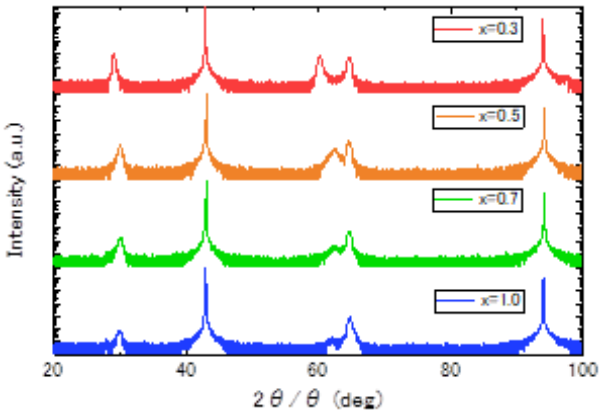

Fig.2 Out of plane XRD of FCS (x=0.3, 0.5,0.7 1.0)

Reference

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