Structural, magnetic and transport properties of Ni$_2$MnAl thin films prepared by magnetron sputtering

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Mn$_3$Ir is an antiferromagnetic material widely used in so-called spin valve structures. The spin valve structure plays an important role for enhancing sensitivity of magnetic sensors such as reading heads of hard disc drives (HDDs). Mn$_3$Ir has attractive properties of large exchange bias field and high blocking temperature, however high-cost of Ir will be a critical issue in near future for its scarcity. In this work, we focused on an anti-ferromagnetic Heusler alloy Ni$_2$MnAl for the replacement of Mn$_3$Ir. Ni$_2$MnAl is known to be an antiferromagnetic phase when the structure is B2 phase [1]. There have been few reports on fabrication of Ni$_2$MnAl thin films therefore structural and magnetic property of Ni$_2$MnAl thin films were investigated in this study.

Ni$_2$MnAl thin films were prepared on MgO (100) substrates by magnetron sputtering. Film composition was adjusted to be a stoichiometric composition by co-sputtering technique. Structural, magnetic, and transport properties of the films were measured by using x-ray diffractometer (XRD) and van der Paw technique, respectively.

Fig. 1 shows the XRD result of the samples deposited at different substrate temperatures ($T_{\text{sub}}$). Peak intensity of Ni$_2$MnAl increases with increasing $T_{\text{sub}}$ and (002) diffraction which comes from B2 phase was confirmed for the samples prepared at $T_{\text{sub}}$ over 300°C. Fig. 2 shows measurement temperature dependence of electrical resistivity for the sample of $T_{\text{sub}} = 500$°C. The graph has an inflection point at 250K which implies magnetic transition of the Ni$_2$MnAl film. Magnetic properties measured by VSM and synchrotron x-ray source will be discussed in the presentation.

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