

# Magnetic and Microstructural Properties of MnBi Films

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Low-temperature phase (LTP) of MnBi has attracted much attention due to its larger coercivity than that of Nd-Fe-B at high temperature [1]. Moreover, according to the theory of exchange-coupled core-shell magnet, when the LTP-MnBi is used as a hard magnetic core and combined with soft magnetic shell, the maximum energy product  $(BH)_{\max}$  is estimated to overcome that of Nd-Fe-B. In this regards, there have been many efforts [2] to obtain the LTP-MnBi thin films for the exchange-coupled magnets. Here, we present the structural and magnetic properties of LTP-MnBi thin films. The films were synthesized on a glass substrate by using a UHV sputtering system. In order to form the desired alloy with c-axis texture, the films were annealed in the temperature range of 350°C ~ 400°C for 1~2 hours. XRD results confirmed that all the films were well grown with the c-axis orientation. The elemental composition of the main phase was investigated with EDX. From the analysis of out-of-plane M-H hysteresis loop, we found that the ratio of Bi/Mn strongly has an effect on the magnetic properties of LTP-MnBi films. The highest value of  $(BH)_{\max}$  of LTP film was obtained to be ~ 6.6 MGOe at room temperature when the thicknesses of Bi and Mn were adjusted in 30nm and 20nm, respectively. The magnetic properties of exchange-coupled MnBi with various soft layers such as FeCo and Fe will be discussed in detail.

[1] T. Chen and W. E. Stutis, IEEE Trans. Magn, 10, 581-586 (1974).

[2] B. Li, W. Liu, X.G. Zhao, W.J. Gong, X.T. Zhao, H.L. Wang, D. Kim, C.J. Choi and Z.D. Zhang, J. Magn. Mater, 372, 12-15 (2014).