# Fabrication of $Mn_2VAl$ full-Heusler epitaxial thin films for spin wave devices

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The ferromagnetic materials with low magnetic damping are promising for waveguides on spin wave propagating devices, because propagation length of spin waves is expected to be long in low damping materials. $Mn_2VAl$ full-Heusler alloy is theoretically predicted to be half-metal and is expected to have low magnetic damping constant. $Mn_2VAl$ is known as ferrimagnet, however, its magnetic damping have not been reported. In this work, we fabricated highly ordered $Mn_2VAl$ epitaxial thin films by using magnetron sputtering and characterized the structural and magnetic properties.

We fabricated four series of $Mn_2VAl$ thin films on MgO(001) substrates as follows. A : $Mn_2VAl$ (50 nm), $T_s$ = 300-700°C, B : Cr (40 nm)/$Mn_2VAl$ (50 nm), $T_a$ = 300-700°C, C : MgO (20 nm)/$Mn_2VAl$ (50 nm), $T_a$ = 300-700°C, D : MgO (20 nm)/$Mn_2VAl$ (50 nm), $T_s$ = 300-700°C. The films were capped by 3-nm-thick Ta. The crystal structure and magnetic properties were measured by XRD and VSM, respectively. The damping constant was evaluated by ferromagnetic resonance (FMR).

Figs. 1 and 2 show $T_a$ and $T_s$ dependences of order parameter of $L2_1$ phase ($S_{L21}$) and saturation magnetization ($M_s$). As shown in Fig. 1, $Mn_2VAl$ had $L2_1$ structure at 500-600°C in all series. In series D, we obtained the highest $L2_1$-order parameter $S_{L21}$ ~ 0.75 and the value was much higher than $S_{L21}$ ~ 0.45 in the previous report [1]. Saturation magnetization showed maximum at around 500-600°C in all series of $Mn_2VAl$ films, and the highest $M_s$ value was 242 emu/cc at $T_s$ = 500°C in series A. The observed magnetization was much higher than reported value of 150 emu/cc [1], but lower than theoretical value of 300 emu/cc. We will report magnetic damping constant in these $L2_1$ ordered $Mn_2VAl$ films. This work was partially supported by KAKENHI (24226011) and Interdepartmental Doctoral Degree Program for Multi-dimensional Material Science Leaders. [1] T. Kubota *et al.*, J. Magn. Soc. Jpn., **34**, 100-106 (2010).

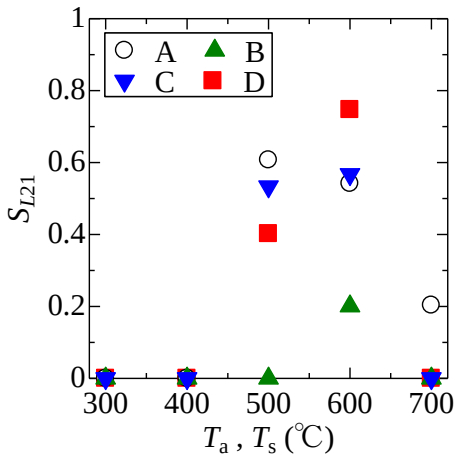


Fig. 1 $T_a$ and $T_s$ dependence of order parameter of $L2_1$ phase $S_{L21}$

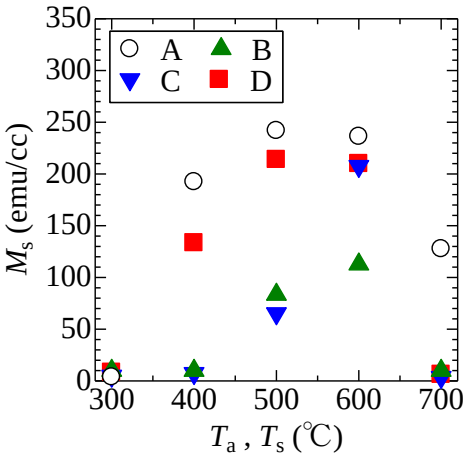


Fig. 2 $T_a$ and $T_s$ dependence of saturation magnetization $M_s$