Anisotropic Magnetoresistance Effects in Epitaxial Thin Films of Mn_2VAl Full-Heusler Alloy

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Mn-based full-Heusler ferrimagnet, Mn_2VAl is an ideal source for spin injection because of its high spin polarization and low magnetization, however, the magneto-transport properties of the thin films have scarcely been reported. According to Kokado's model, it will be possible to clarify the electron spin in charge of electric conduction through anisotropic magnetoresistance (AMR) measurements [1]. Therefore, AMR effects of Mn_2VAl thin films were investigated in this study.

A 50-nm-thick Mn_2VAl thin film was epitaxially grown on a MgO (001) single-crystal substrate using a magnetron sputtering technique. Details of structural and magnetic properties of the film were previously reported [2]. AMR effect was measured in the 10-300 K range using DC four-probe method of a Quantum Design physical properties measurement system. During the measurement, a 50-kOe magnetic field was applied to the sample, and current was applied to the stripe formed along the Mn_2VAl [110] direction.

Fig. 1 shows the AMR curves $(\rho(\theta)-\rho_\perp)/\rho_\perp$ of the Mn_2VAl films. All the observed AMR signs were negative $(\rho_\parallel < \rho_\perp)$. The density of states for the spin-up in Mn_2VAl shows the energy gap at the Fermi level [3]. Therefore, $s_\downarrow \rightarrow d_\downarrow$ is a dominant scattering process in Mn_2VAl. Fig. 2 shows Fourier coefficients for the cos 2θ $(C_{2\theta})$ and cos 4θ $(C_{4\theta})$ terms. In addition to the appearance of the conventional $C_{2\theta}$, the $C_{4\theta}$ also appeared, which was caused by the tetragonal distortion [4]. From this study, it was found that the prepared Mn_2VAl films were possible to possess half-metallicity.

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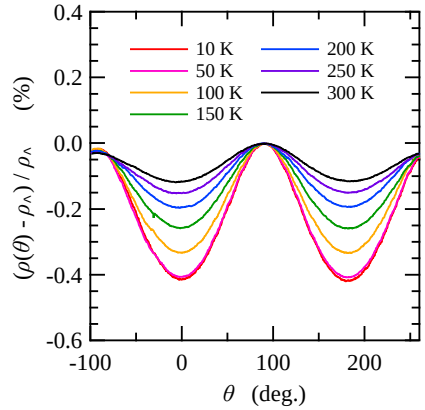

Fig. 1 AMR curves measured in 10-300 K range.

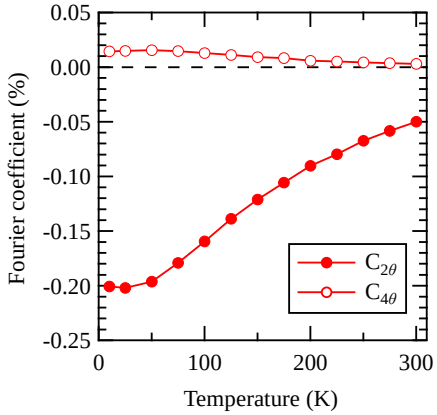

Fig. 2 Fourier coefficients for the cos 2θ and cos 4θ.