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FMR Study on Single Crystalline Co₂MnAl Heusler Alloy Thin FilmsA. N. Kocbay¹, R. Yilgin^{1*}, B. Aktas¹, M. Oogane², Y. Ando², and T. Miyazaki²¹ Gebze Institute of Technology, Science Faculty, Department of Physics, Cayirova, 41410-Gebze, Kocaeli, Turkey² Tohoku University, Graduate School of Engineering, Department of Applied Physics, Aoba-yama 6-6-05, Sendai 980-8579, Japan

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The discovery of the giant magneto-resistance (GMR) and the large tunnel magneto-resistance (TMR) effect at room temperature have attracted great attention to the spintronics studies. After understanding high spin polarization in some kinds of Heusler alloys such as Co₂MnSi, Co₂MnAl, etc., many scientists predict a large potential for applications of these alloys in spin-electronics devices, especially for producing magnetic random access memory (MRAM), and present-day communication industries. Therefore intensive experiments have been carried out to determine the magnetic properties of Heusler alloys in recent years [1].

Gilbert damping constant, $G = \alpha \gamma M_s$, (in here α and γ are, respectively, intrinsic damping parameter and gyro-magnetic ratio and M_s is saturation magnetization), of ferromagnetic materials is extremely important for achieving high-speed magnetization switching for MRAM and reduction of critical current density for spin-transfer-driven magnetic reversal [2].

Samples have been prepared using the magnetron sputtering technique on a MgO(100) substrate for single crystalline and then annealed at various temperatures to control the structure. The magnetic properties such as g -value, effective magnetization and magneto-crystalline anisotropy constants and intrinsic Gilbert damping constant were obtained from angular dependences of FMR spectra using the Landau-Lifshitz-Gilbert equation [3].

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[1] T. Ambrose, J. J. Krebs and G. A. Prinz, APL, 76, 3280 (2000).

[2] J.C. [Slonczewski, J. Magn. Magn. Mater. 159, L1 (1996).

[3] R. Yilgin, M. Oogane, S. Yakata, Y. Ando and T. Miyazaki, IEEE Transactions on Magnetics, 41 (2005) 2799, R. Yilgin, M. Oogane, Y. Ando and T. Miyazaki, J. Magn. Magn. Mater., 310, 2322 (2007), R. Yilgin, Y. Sakuraba, M. Oogane, S. Mizukami, Y. Ando, T. Miyazaki, Jpn. J. Appl. Phys., 46, L205 (2007).

ES04

Preparation and Characterization of NiFe Epitaxial Thin Films Grown on SrTiO₃(100) and MgO(100) Single-Crystal SubstratesT. Tanaka^{1*}, M. Ohtake¹, M. Futamoto¹, F. Kirino², and N. Inaba³¹ Faculty of Science and Engineering, Chuo University, Bunkyo-ku, Tokyo 112-8551, Japan² Tokyo National University of Fine Arts and Music, Taito-ku, Tokyo 110-8714, Japan³ Department of Electrical and Electronic Engineering, Yamagata University, Yonezawa 992-8510, Japan

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NiFe multilayer films combined with thin insulator layers are widely investigated for device applications such as TMR-heads and MRAMs. Theoretical calculations show that the tunneling magnetoresistance of magnetic sensor prepared using an epitaxial film is one order of magnitude greater than that obtainable with an amorphous film [1,2]. The crystallographic properties of NiFe/insulator structure give strong influence on the tunneling magnetoresistance. In the present study, Ni₈₂Fe₁₈ films were prepared on SrTiO₃(100) and MgO(100) single-crystal substrates by UHV-MBE. The growth process, the crystallographic quality, and the magnetic properties of these films were investigated.

NiFe epitaxial thin films were obtained on both SrTiO₃(100) and MgO(100) substrates. A clear RHEED pattern reflecting fcc(100) structure was observed for a NiFe film grown on an SrTiO₃(100) substrate throughout the course of deposition, as shown in Figs. 1(a) and 1(b). However, in early stage of NiFe film growth on an MgO(100) substrate, an NiFe(1120) bi-crystalline epitaxial film with hep structure was observed, as shown in Fig. 1(c). With increasing the film thickness, fcc-NiFe(100) phase appeared. The RHEED intensity of fcc phase increased and the RHEED pattern of fcc reflection overlapped with that of hep reflection (Fig. 1(d)). Fig. 2 shows the magnetization curves. The magnetic properties of these epitaxial films reflect the magnetocrystalline anisotropy of bulk fcc-NiFe crystal. The coercivities are less than 3.5 Oe for both films. The Gilbert's damping constants are investigated by using an FMR system.

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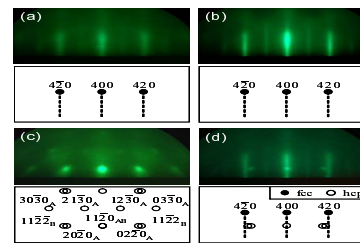


Fig. 1. RHEED patterns observed for NiFe thin films grown on SrTiO₃(100) (a), (b) and MgO(100) (c), (d) deposited at 300 °C. The film thicknesses are 5 nm (a), (c) and 40 nm (b), (d), respectively.

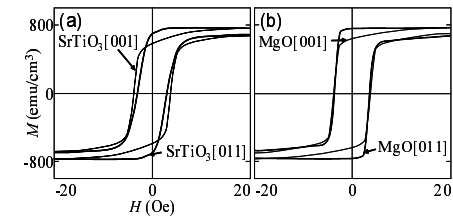


Fig. 2. Magnetization curves of 40 nm-thick NiFe thin films prepared on (a) SrTiO₃(100) and (b) MgO(100) substrates.

[1] W.H. Butler et al., Phys. Rev. B, 63, 054416 (2001).

[2] J. Mathon et al., Phys. Rev. B, 63, 220403 (2001).