Epitaxial Growth and Magnetic Properties of Fe/MgO/InAs(001) Heterostructures

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Electrical injection of spin-polarized electrons from a ferromagnetic metal (FM) into a semiconductor (SC) has great interest in the application of spintronics. The epitaxially grown MgO tunnel barrier between FM and SC has been widely introduced to overcome the conductivity mismatch that prevents efficient spin-polarized electron transfer from FM to SC. Recently, the use of alternative SC substrates is introduced to improve the efficiency of spin-polarized electron transfer. Among the SC substrates, we focus on InAs substrate due to long spin relaxation time and large spin-orbit coupling strength. In the previous study[1)], the mirostructural evolution of epitaxial Fe/MgO layers grown on InAs(001) with respect to MgO growth temperature was investigated. However, the relation between structural properties and magnetic properties was not shown clearly. In this study, 4 nm thick MgO thin films and the subsequent 7 nm thick Fe layers were grown on InAs(001) substrates by a molecular beam epitaxy system and magnetic properties was measured by a vibrating sample magnetometer. Figure 1 shows the hysteresis loops for Fe/MgO/InAs thin film. It is well known that the thin Fe two dimensional layer shows magnetization switching including both domain wall motion and magnetization rotation. On the other side, when the magnetic field is applied perpendicular to the film plane, magnetization reversal takes place by only magnetization rotation. From the results, we investigate the detailed relation between the microstructures and magnetic properties by using energy equation with single domain assumption[2)].

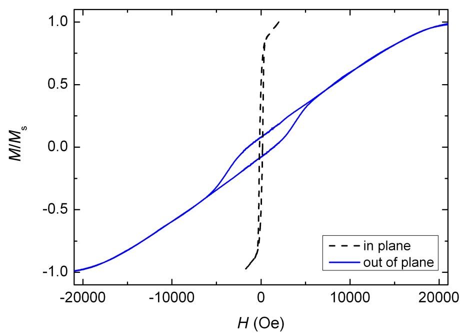

Fig 1. VSM hysteresis loops of the Fe/MgO/InAs with the MgO layer grown at 200℃.

Reference

[1] K. H. Kim *et al.*, Cryst. Growth Des., **11**, 2889 (2011).

[2] Y. J. Nam and S. H. Lim., Thin Solid Films, **519** 8256 (2011).