Graphene on the $L1_0$-ordered alloy epitaxial films

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$L1_0$-ordered alloys are attracted much attention for use in magnetic recording media of HDD, and non-volatile magnetic random-access memory (MRAM) because of their high uniaxial magnetocrystalline anisotropy constant (MAC) and low damping constant (α_{eff} ~0.007). [1] The $L1_0$-FePd ordered alloy films can switch the magnetization with low energy consumption. However, $L1_0$-ordered alloy has a large lattice misfit (~10%) to the MgO barrier which degrades smooth interface and tunnel magnetoresistance ratio (TMR). In the case of MgO barrier, the thickness is already less than 1 nm in order to reduce resistance-area (RA) product. Graphene (Gr) can be formed without concern of the epitaxial relationship and also GF has a low RA product. [2] Furthermore, Gr can induce perpendicular magnetic anisotropy at the interface. [3] Perpendicular magnetized magnetic tunnel junctions (*p*-MTJs) using $L1_0$-ordered alloy films and Gr are useful in highly integrated MRAM systems. In this study, crystal structure and interfacial properties were investigated for Gr on atomically flat $L1_0$-FePd epitaxial films. $L1_0$-FePd films were grown on the $SrTiO_3$ (100) substrates (lattice misfit ~1%) by highly vacuumed (2×10^{-7} Pa) r.f. magnetron sputtering followed by post-annealing at 700°C for 90 min. After removing the surface oxide layer by chemical etching, Gr was deposited by chemical vapor deposition method. [2] The surface roughness of the FePd films by atomic force microscopy was *R*a of less than 0.4 nm. The structure of the $L1_0$-FePd films were evaluated by out-of-plane X-ray diffraction and cross-sectional scanning transmission electron microscopy (STEM). The $L1_0$-FePd was epitaxially grown on the $SrTiO_3$ substrate and a local contrast less than 5 nm in diameter was observed by STEM. Optical Kerr measurements showed that the remanence magnetization (M_r/M_s) at zero magnetic field was 0.2 and it was approximately 1.0 when a magnetic field of ~100 Oe was applied. It may consider that the magnetic domains of FePd aligned anitiferromagnetically without magnetic field due to small domains. The interface between FePd and Gr was confirmed by glance angle X-ray photoelectron spectroscopy (XPS), and no chemical reaction and oxidation could be observed; the Gr was successfully grown on the $L1_0$-FePd epitaxial films. We will also improve low M_r/M_s by reducing lattice mismatch using other perovskite substrate such as $(La_{0.3}Sr_{0.7})(Al_{0.65}Ta_{0.35})O_3$.

Reference : [1] H. Naganuma, *et al.*, Nano Letters, **15**, 623 (2015). [2] S. Mzail, *et al.*, Appl. Phys. Lett., **109**, 253110 (2016). [3] H. Yang, *et al.*, Nano Lett., **16**, 145 (2016).

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