MgO-based Magnetic Tunnel Junctions with a Synthetic Free Layer Consisting of FeB/Ru/Ferromagnet

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1. 서 론

The spin-transfer switching(STS) in MTJs using synthetic ferrimagnetic(SyF) free layers have been studied because it can provide both large volume to withstand thermal stability and a reduction in switching current. It is reported theoretically that switching rate of the synthetic free layers is strongly dependent on the strength of exchange coupling between two ferromagnetic layers[1].

Therefore, we elucidated how the magnetic properties and tunneling magneto-resistance(TMR) of MgO-based magnetic tunnel junctions(MTJs) with synthetic free layer is affected by the materials and the strength of exchange coupling.

2. 실험방법

The MTJ stack consists of substrate/ Ta (5)/ CuN (30)/ Ta (5) / PtMn (20)/ CoFe (3)/ Ru (5) / MgO (1.1)/ $Co_6Fe_2B_2$ (2)/ Ru (t_{Ru})/ FM (2)/ CuN (10)/ Ru (7), where FM is Co or Ni(thickness in nm). The magnetic tunnel junctions were fabricated by electron beam lithography and Ar ion milling. The magnetic properties were measured using a vibrating sample magnetometer(VSM) and the TMR properties were measured using a 4-probe method at room temperature.

3. 실험결과 및 고찰

We fabricated CoFeB /Ru /Ni and CoFeB /Ru /Co trilayers to investigate their magnetic properties. With as-deposited films, the dependence on Ru thickness of saturation field shows the oscillatory behavior with local maximum of t_{Ru}=0.9 nm for Ni case, 1.1 nm for Co case, respectively. After annealing at 300℃, the change of the interlayer coupling strength becomes more significant for the CoFeB /Ru /Ni trilayer than the CoFeB /Ru /Co trilayer.

The MTJs with CoFeB /Ru /Co free layer show a relatively higher TMR and larger coercivity field(H_c) compared to those of the MTJs with CoFeB /Ru /Ni free layer.

4. 참고문헌

[1] T.Taniguchi *et al.*, Phys. Rev. B 83, 054432 (2011)