Temperature dependence of tunnel magnetoresistance of IrMn based MTJ

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The temperature dependence of spin-polarized tunneling magnetoresistance (TMR=$(R_A-R_P)/R_A$) is investigated between 30 K and 300 K for as deposited and annealed junctions with the structure of Ta(5)/Cu(10)/Ta(5)/NiFe(2)/Cu(5)/IrMn(10)/CoFe(2.5)/Al-O/CoFe(2.5)/**NiFe(t)**/Ta(5), where **t** = 10 and 100 nm. MTJ's were prepared on thermally oxidized Si wafers using DC magnetron sputtering with ultra clean Ar(9N) as the process gas, in a chamber with base pressure of 4×10^{-9} hPa [1]. The samples were annealed in vacuum (10^{-6} hPa) at 200°C, 270°C and 300°C for 1 hour under a magnetic field of 80 kA/m, followed by field cooling. The junction magnetoresistance decreased for annealed samples at 270°C and 300°C (where maximum of TMR is observed) and increased for as deposited and annealed at 200°C with increasing temperature (Fig.1). The experimental results of TMR of the junction with t = 100 nm are successfully described by a model that includes electron polarization P that decreases with T due to thermally excited spin waves according to $P \propto (1-\alpha T^{3/2})$ [2], Fig.2. From Julliere's model it can be obtained that difference of parallel and antiparallel conductance is proportional to the electron spin polarizations of ferromagnetic electrodes $\Delta G = G_P - G_A \propto P_1 P_2$.

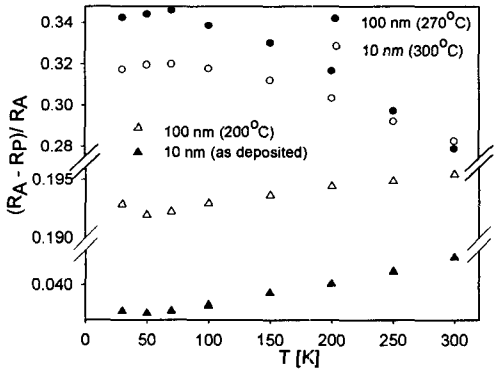

Fig.1

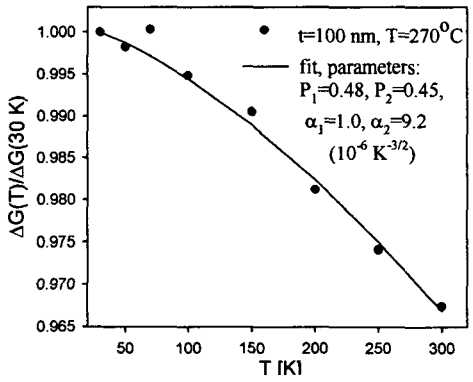

Fig.2

References

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[2] C.H. Shang, J. Nowak, R. Jansen, J.S. Moodera, Phys. Rev. B 58 (1998) R2917.