Junction size dependence of damping constants in nanoscale CoFeB/MgO magnetic tunnel junctions

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We reported magnetic properties of the free layer in nanoscale perpendicular magnetic tunnel junctions (p-MTJs) investigated by homodyne-detected ferromagnetic resonance (FMR) [1]. In the previous studies on p-MTJs, the FMR was measured under in-plane magnetic fields, and the tilt of magnetization of the free layer resulted in extrinsic contributions, such as two-magnon scattering, to spectral linewidths. In this study, we measure FMR of nanoscale CoFeB/MgO MTJs with a free layer with perpendicular easy axis and a reference layer with in-plane easy direction under a perpendicular magnetic field H_{perp} in order to suppress the extrinsic contributions and evaluate a damping constant α in the free layer.

A stack structure, Ta (5 nm)/ PtMn (20 nm)/ Co (2.6 nm)/ Ru (0.9 nm)/ $Co_{18.75}Fe_{56.25}B_{25}$ (2.4 nm)/ MgO (1.1 nm)/ $Co_{18.75}Fe_{56.25}B_{25}$ (1.8 nm)/ Ta (5 nm)/ Ru (5 nm), is deposited by dc/rf magnetron sputtering on a sapphire substrate. The stack is processed into circular MTJs with junction diameter D from 71 to 100 nm on a coplanar waveguide. The top CoFeB layer is the free layer with perpendicular easy axis. The bottom CoFeB is a reference layer with in-plane easy direction, which couples antiferromagentically through Ru with Co pinned by PtMn.

We measure FMR spectra by sweeping the frequency of rf signal under various H_{perp}. The linear dependence of FMR linewidth Δf on resonance frequency f_r is obtained. The values of damping constant α is determined to be ~0.01 from the slope of the Δf vs. f_r, and are nearly independent of D [2]. The obtained values of α are similar to those reported for blanket CoFeB films with similar free layer thickness determined by vector-network-analyzer FMR [3].

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