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Characterization of perpendicular STT-MRAM by spin torque ferromagnetic resonance[1] CHENGCEN SHA, LIU YANG, HAN KYU LEE, IGOR BARSUKOV, JIEYI ZHANG, ILYA KRIVOROTOV, University of California, Irvine — We describe a method for simple quantitative measurement of magnetic anisotropy and Gilbert damping of the MTJ free layer in individual perpendicular STT-MRAM devices by spin torque ferromagnetic resonance (ST-FMR) with magnetic field modulation. We first show the dependence of ST-FMR spectra of an STT-MRAM element on out-of-plane magnetic field. In these spectra, resonances arising from excitation of the quasi-uniform and higher order spin wave eigenmodes of the free layer as well as acoustic mode of the synthetic antiferromagnet (SAF) are clearly seen. The quasi-uniform mode frequency at zero field gives magnetic anisotropy field of the free layer. Then we show dependence of the quasi-uniform mode linewidth on frequency is linear over a range of frequencies but deviatesfrom linearity in the low and high frequency regimes. Comparison to ST-FMR spectrareveals that the high frequency line broadening is linked to the SAF mode softening near the SAF spin flop transition at 5 kG. In the low field regime, the SAF mode frequency approaches that of the quasi-uniform mode, and resonant coupling of the modes leads to the line broadening. A linear fit to the linewidth data outside of the high and low field regimes gives the Gilbert damping parameter of the free layer.

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