QUANTIZED SPIN WAVE MODES IN MAGNETIC TUNNEL JUNCTIONS

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We have studied the magnetic field dependence of the mode frequency of thermally excited spin waves in 100 nm x 200 nm rectangular shaped nanopillars patterned from magnetic tunnel junctions of composition CoFeB (2 nm)/ MgO (0.85)/ CoFeB (3)/ Ru(0.8)/ CoFe(2.5)/ MnIr(8). An example of the measured voltage noise power density (a.u., log scale) versus ascending field applied along the short edge (hard axis) and along the long edge (easy axis) of the rectangle is shown in the figure below. The general appearance of the spectra is strongly sample dependent. On the easy axis, most of modes observed for fields below the spin-flop transition of the synthetic antiferromagnet (SAF) can be modeled as exchange-dipolar spin wave modes excited in the free layer using the model in [1] under the assumption of mixed boundary conditions. The effective magnetization and exchange constant are thereby found to be about 4 times smaller than the bulk values. Surprisingly, the spin-flop seems usually not to take place in a single step, but is preceded by a steady decrease in resistance indicating some smooth transition in the SAF. Hard axis spectra cannot be fitted in a satisfying way using the parameters extracted from the corresponding easy axis spectra. The reason is most probably the existence of some nonuniform magnetization distribution as suggested by the occurrence of several v-shaped minima and the unexpected and in some cases very strong asymmetry of the spectra, which cannot be explained by a slight misalignment of the applied field with the hard axis.

Acknowledgment: A. H. is supported by a PhD grant from the EU under the 6th FP for the Marie Curie Research Training Network SPINSWITCH, MRTN-CT-2006-035327.

[1] K. Guslienko et al., PRB 68, 024422 (2003)