FMR SPECTRA OF EXCHANGE-BIASED FM/AFM BILAYER SIMULATED WITH INTERVAL METHODS

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9.7 cm

The bilayer of ferromagnetic (FM) and antiferromagnetic (AFM) material, FeNi/FeMn, both 50 Å thick, exhibits an exchange bias effect as high as 420 Oe at 6 K and 7 Oe at 50 K, when first cooled down in presence of an in-plane field of 100 Oe. Similar effect, that is different values of the resonance fields when an external field is oriented in opposite directions, can be seen in FMR experiments performed at 9.248 GHz (X-band). Using the expression for the free energy density proposed by Hu *et al.* (JMMM **301**:238, 2006), it was possible to simulate this behavior with high precision, without any simplifications and for arbitrary orientation. The following terms, besides the Zeeman term and shape anisotropy, were taken into account: two kinds of uniaxial anisotropy (in-plane and out-of-plane) of the FM layer, bilinear (Heisenberg) and biquadratic exchange couplings between FM and AFM layer, as well as the energy of the domain walls located at the interface. The FM saturation magnetization was the sixth parameter to be estimated from available experimental data.
Interval simulations have revealed 1, 2 and sometimes even 4 nearby equilibrium orientations of FM magnetization vector (at resonance) when the field has a component antiparallel to that of cooling field, while only 1 such position when field points in the opposite direction. In both cases only a single resonance line is observed.

13.4 cm

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