Nonrelaxational FMR peak broadening in martensitic films

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Potential applications of magnetic shape memory alloys (MSMAs) are ranging from magnetic nanoelectronics to magnetic refrigeration and magnetic actuators [1,2]. Most of these applications require extensive knowledge about the magnetic properties of these materials and the relation of their magnetic and magnetodynamic parameters with structural and electronic ones.

Here we combined the statistical model of the spatially inhomogeneous martensitic state of a thin film with the well-elaborated Landau theory of cubic-tetragonal MTs observed in the widely studied Ni-Mn-Ga alloys. Although in real martensitic films, the symmetry of the martensitic phase can be lower (orthorhombic for instance) the theoretical results, reported here, provide a satisfactory description of the observed temperature dependence of FMR peak width.

It has been shown that spatial inhomogeneity of real MSMAs leading to a difference of "local" MT temperatures can result in "local" variation of magnetic anisotropy constants. Such differences in anisotropy constants can increase or decrease with the temperature decrease depending on the influence of inhomogeneities on MT parameters. The proposed theoretical model allowed describing dramatic broadening of the FMR line with the temperature decreasing in epitaxial films of MSMAs. It is worth to be noted that such inhomogeneity can result in nontrivial temperature behavior of the net anisotropy of these compounds. Although the consideration here is mainly focused on the analysis of FMR linewidth but obtained results can be easily adapted for the analysis of magnetometry data (magnetic susceptibility, hysteresis loops, etc.) which are widely used for the investigation and characterization of MSMAs.

References:

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