Influence of the demagnetizing field on the spin-wave softening in bicomponent magnonic crystals

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In bi-component magnonic crystals (MCs) demagnetizing field occurs around interfaces between a matrix and inclusions. As it is already shown this field strongly influences the spin-wave spectrum including the position and the width of band gaps and their response to the change of the external magnetic field [1, 2]. Here, we show its effect on the reversal of the mode order in the spectrum. The reversal of modes means that the modes which are excited mostly in the material with higher saturation magnetization have lowest frequencies then modes excited in the material with low saturation magnetization. We address this effect to the mode-dependent softening of spin waves resulting from the growing influence of the demagnetizing field while the external magnetic field lowers. The effect gives a possibility of tuning the concentration of spin-waves in one of the constituent materials – the matrix or scattering centres – by the external magnetic field. As an example, we study planar bi-component MCs consisting of cobalt inclusions in permalloy matrix, as well as Py inclusions in Co matrix. We show that in both cases lowering external magnetic field drives down in the spectrum these modes which are excited mostly in Co. Moreover, the concentration of such modes in Co is enhanced.

References:

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