MAGNONIC CRYSTAL THEORY OF THE SPIN-WAVE FREQUENCY GAP IN LOW-DOPED $La_{1-x}Ca_xMnO_3$ MANGANITES

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9.7 cm

This study is devoted to an investigation of the spin wave spectrum in 3D periodic macrostructure composed of two ferromagnetic materials: spherical ferromagnetic grains disposed in the nodes of a bcc crystal lattice are embedded in a matrix with different ferromagnetic properties. Frequency ranges forbidden to spin wave propagation are found to exist in the calculated magnonic spectrum, with both the position and the width of the gaps depending on the magnetic (exchange and magnetization) contrasts in the composite material, as well as on its structural parameters (filling fraction). This theoretical study refers to the recent finding of a spin-wave gap in low-doped $La_{1-x}Ca_xMnO_3$ manganites (in neutron scattering experiments [1]); this experimental study contained a suggestion that the magnetic ground state in the studied samples could be inhomogeneous, with ferromagnetic droplets embedded in a canted antiferromagnetic matrix. Therefore, we model the respective manganite sample as a magnonic crystal, in which droplets are disposed in a *regular* bcc lattice; the respective magnetic contrast values are estimated on the basis of the available experimental data. A very reasonable estimation of the droplets mean size and spacing is obtained by fitting the magnonic frequency gap resulting from our theoretical study to that found experimentally.
[1] P. Kober-Lehouelleur *et al.*, Phys. Rev. B **70**, 144409 (2004).

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