A plane-wave theory of three-dimensional magnonic crystals

M. Krawczyk and H. Puszkarski

Surface Physics Division, Faculty of Physics, A. Mickiewicz University
Umultowska 85, 61-614 Poznań, Poland

The dynamics of magnetic moments in ferromagnets is well described by phenomenological Landau-Lifshitz (LL) equation. In the case of *nonhomogeneous* ferromagnetic materials with *periodically* modulated material parameters (such as spontaneous magnetization, exchange integral or anisotropy), the plane-wave method, commonly used for calculating the band structure of photonic and phononic crystals, can be resorted to in resolving the LL equation in linear approximation. In this study, the plane-wave method is used for determination of the spin-wave dispersion relation in magnetic composites showing periodicity in all *three dimensions*. We present the results of calculations referring to a model *magnonic crystal* consisting of ferromagnetic spheres disposed in nodes of a 3D crystal lattice and embedded in a ferromagnetic matrix whose magnetic properties differ from those of the spheres. The effect of material and structural parameters on the spin-wave dispersion is analyzed in detail, with special attention paid to the conditions of gap opening in the magnonic spectra (*cf.* [1, 2]).

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[1] H. Puszkarski and M. Krawczyk, Solid State Phenomena **94** (2003)125.
[2] M. Krawczyk and H. Puszkarski, Cryst. Res. Technol. **41** (2006) 547.

Name of the presenting author (poster): Maciej Krawczyk
e-mail address: krawczyk@amu.edu.pl
url's: http://www.staff.amu.edu.pl/~zfp/