ACOUSTICS2008/1042
Complete band gap in the phonon spectra of compact ceramics

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The processes of sound propagation in inhomogeneous systems have long the focus of researchers attention. The new interest in this problem i last years has been inspired by the appearance of artificial elastic periodic structures - phononic crystals. Since the lattice parameter artificial phononic crystals is about several millimetres the complete bandgap is assumed to lie in the megahertz range. It is of fundamental importance for modern radio equipment to obtain phononic crystals with forbidden bandgap in the gigahertz range, which requires generation of phononic lattices with the period of the order of tens and hundreds nanometers. The author belives nanoceramics compacted from a superfine powder in a special way to be very promising systems for the generatio such phononic lattices.
In this work the phonon spectra of the model two-dimensional ceramics numerically calculated using the finite-difference time-domain (FDTD) method. To interpret the results,the analytical expressions obtained for an elastic limit are used, which enables formalization of the conditions necessary for the appearance of a gap in a phonon spectrum. The possibility of creation of bulk acoustic waves resonators is discussed.