ACOUSTICS2008/1945
Thermal shifting of phononic bandgaps in barium strontium titanate-based structures

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Phononic crystals, which are structures with periodic variations of density and/or sound velocities, can exhibit phononic bandgaps where propagation of acoustic waves is forbidden. The ability of phononic crystals to manipulate sound, in a similar manner which photonic crystal control light, makes them particularly useful for applications such as acoustic filters or very efficient waveguides. Since the positions of the phononic bandgaps depend solely on the densities and the sound velocities of the constituent materials, it is expected that a modulation in the densities and/or sound velocities of the constituent materials would result in a phononic bandgap shift. It is known that ferroelectric ceramic, such as barium strontium titanate (BST), will undergo a ferroelectric-to-paraelectric phase transition across the Curie temperature. During the phase transition, there is a large variation in the sound velocities of BST which result in a shift of the phononic bandgaps. In this work, we calculated the phononic bandstructures of BST-based structures by the plane-wave expansion method and showed that the phononic bandgaps can be shifted thermally.