Demonstration of complete phononic bandgaps for surface acoustic waves in silicon-based phononic crystals

S. Mohammadi, A. Adibi, and W. D. Hunt
Georgia Institute of Technology, Atlanta, GA, USA
A. Khelif
Institut FEMTO-ST, Besancon Cedex, France

Phononic crystals are acoustic counterparts of photonic crystals. Surface acoustic wave (SAW) based phononic crystals are very interesting due to wide SAW device usage especially in wireless communications and sensing.

Using an FDTD technique, we have demonstrated, for the first time, the existence of a full phononic band gap for surface acoustic waves in a two-dimensional (2D) square lattice of holes etched in a {100}-cut silicon (Si) substrate. The existence of the band gap in the high frequency (several MHz) range is verified experimentally by measuring the transmission spectrum of SAWs through the phononic crystal structure. Good agreement between theory and experiment is assessed.

The primary advantage of using Si for phononic crystals is the possibility of integrating photonic, phononic, and electronic structures in a single substrate. We will show that it is possible to achieve simultaneous bandgaps for both SAWs and optical waves In Si-based periodic structures.