

Absolute band gap and waveguiding in free and supported phononic crystal slabs

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The investigation of acoustic waves in finite slabs of phononic crystals, either free or supported by a substrate, is interesting both for a fundamental understanding of their behaviour as well as for the possibility of designing high frequency devices for telecommunication. Based on the plane wave expansion and finite element method simulations in 2D phononic crystals, the aim of this work is twofold. First, we show that a free slab of a phononic crystal can display an absolute band gap. This may happen if the thickness of the crystal is of same order of magnitude as its period. We discuss the width of the band gap for different lattice structures (square, hexagonal) and different compositions (solid/solid structures, air holes in a solid, including piezoelectricity) of the crystal. We also show that creating a guide inside a slab, for instance by removing a row of cylinders, gives rise to guided modes in the frequency range of the band gap. In a second part, we investigate the same features for a finite slab deposited on a substrate, in particular in the case of an air hole/PZT phononic crystal supported by a Si substrate. This shows the ability of using phononic crystal functionalities in integrated silicon based microdevice technologies.