Acoustic phonon Propagation in 1D and 2_D silicon-based Phononic Crystals

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Abstract

We investigate the acoustic phonon propagation in 1D surface and 2D membrane-based phononic crystals by means of Brillouin spectroscopy. The experimental results supported by numerical calculations performed by the finite element method reveal dispersion features such as zone folding, frequency band gaps and 1-, 2-, and 3D localisation.

The first studied structure is 1D surface PnC in the form of rectangular-like periodic stripes made on the *(001)* surface of silicon. Characteristic sizes, such as lattice spacing (300 nm) and stripe height were intended to result in measurable zone folding and phonon confinement in GHz range. In the second type of measured samples we consider two 2D PnCs formed on 250 nm thick Si membrane. A solid-solid PnCs made of a square lattice of Au pillars on the membrane was found to provide an additional feature (besides those of solid-air PnC) based on the local resonances.

The obtained results provide novel insight regarding the GHz phonon dynamics in the structures potentially attractive for high-frequency applications and heat transport management

References

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Figures

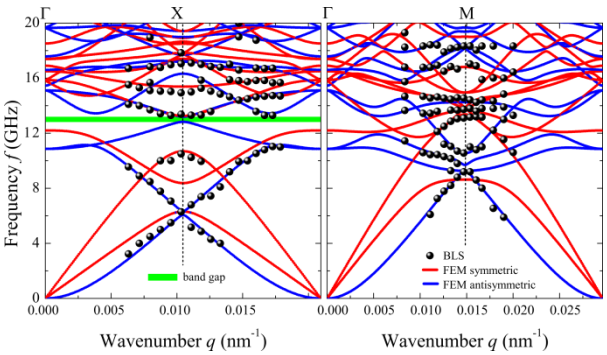

Figure 1 Measured (spheres) and calculated (lines) phonon dispersion of the solid-air PnC (square lattice of air holes in 250 nm thick membrane).

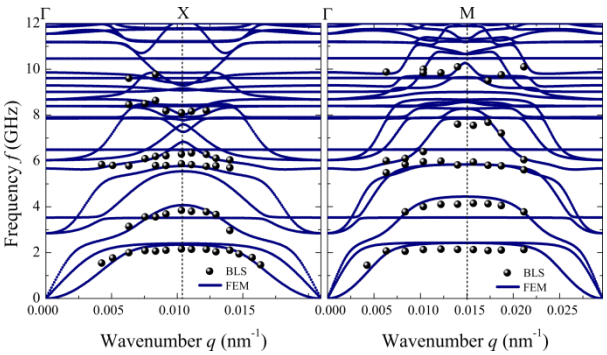

Figure 2 Measured (spheres) and calculated (lines) phonon dispersion of the solid-solid PnC. (square lattice of Au pillars on 250 nm thick membrane).