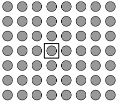
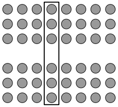
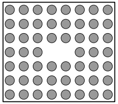
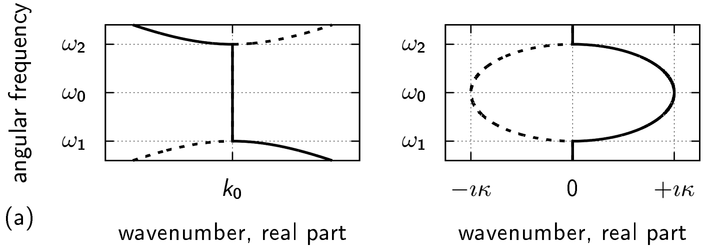
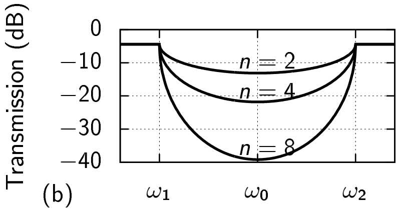
Mirrors, waveguides, and cavities

Basic computational problems for perfectly periodic and defect-based phononic crystals

Structure		Dispersion (infinite structure)	Scattering problem (finite structure)
Crystal		Band structure, $\omega(k)$ Complex band structure, $k(\omega)$	Transmission, reflection, and diffraction of an incident plane wave
Waveguide		Guided modes, with super-cell	Waveguide transmission
Cavity		Confined modes, with super-cell	Cavity transmission

Transmission coefficient within a Bragg band gap





$\boxed{T(\omega_0) \approx -8.7 n\kappa a}$ (dB)

Figure: (a) $k = \pm\imath\kappa$ at the center of the band gap. (b) Transmission for $\kappa a = 0.4$ and $T_0 = 0.6$.

Two-port SAW resonator using phononic crystal mirrors

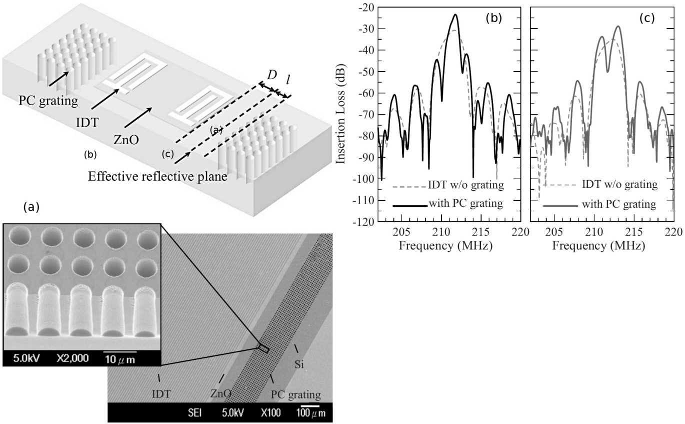


Figure: SQ phononic crystal of holes deeply etched in silicon, $d = 6$ μm and $a = 10$ μm. A thin-layer of ZnO is deposited under the interdigital transducers. (b) $D = \lambda$ and (c) $D = 1.25\lambda$ ($\lambda = 23.4$ μm) [40].

Two-port Lamb wave resonator using phononic crystal mirrors

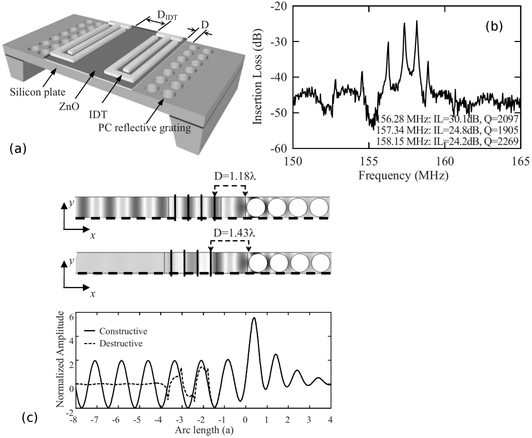


Figure: SQ phononic crystal of holes is etched in silicon, $d = 17.8$ µm and $a = 20$ µm. The thickness of the silicon membrane is $h = 12$ µm. Destructive interference is obtained for $D = 1.43\lambda$. Constructive interference is obtained for $D = 1.18\lambda$ [41]

Fabry-Perot sonic crystal slab resonator

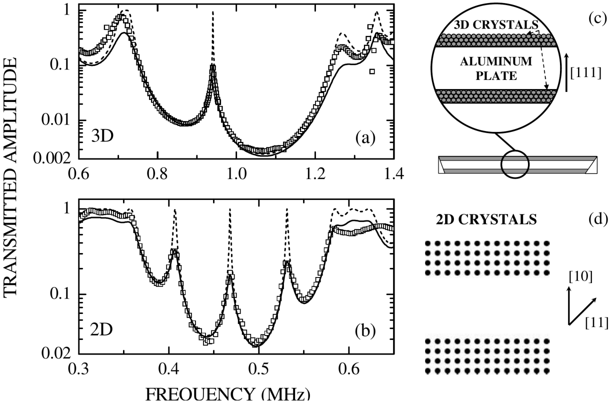


Figure: Amplitude transmission coefficient through (a) 3D and (b) 2D double phononic crystals. Theoretical predictions with and without absorption (solid and dashed lines, respectively) are compared with the experimental data (symbols) [42].

Fabry-Perot silicon phononic crystal slab resonator

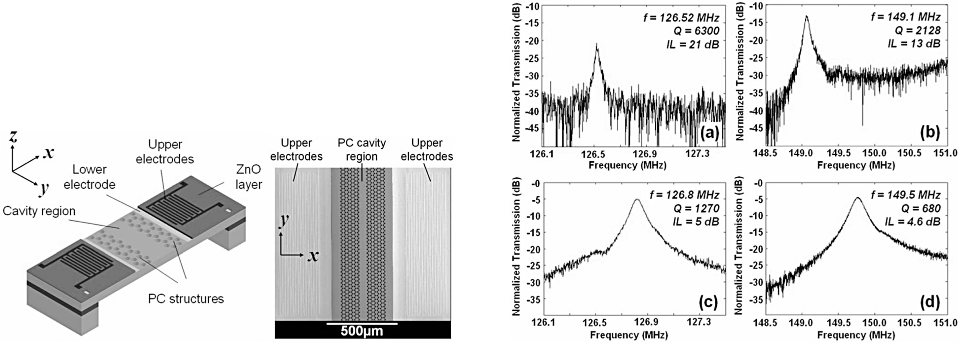


Figure: PC slab resonator structure in silicon [43].

Defect cavities in a SQ sonic crystal of steel rods in water

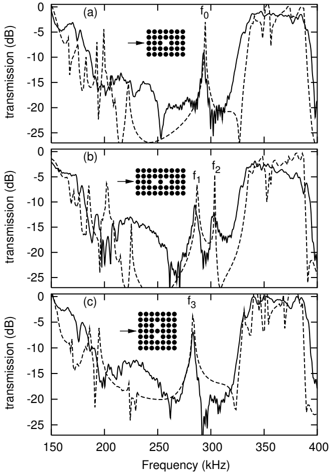


Figure: Full band gap extending from 260 to 312 kHz. $d = 2.5$ mm and $a = 3$ mm. [6]

Linear sonic crystal defect waveguide

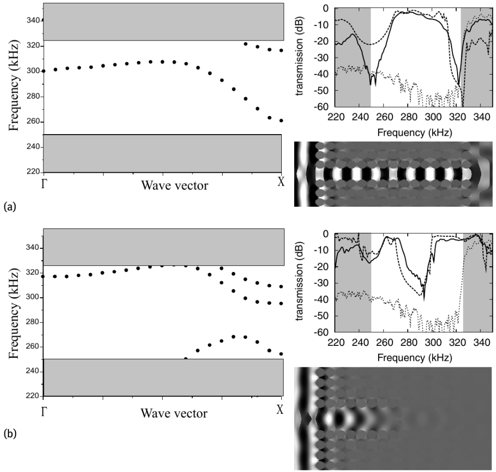


Figure: (a) W1 (b) W2. SQ array of steel rods in water, $a = 3$ mm and $d = 2.5$ mm [44].

Bent defect waveguide in a sonic crystal of steel rods in water

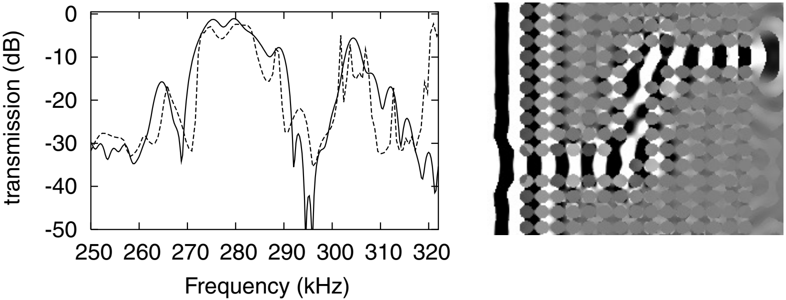


Figure: SQ array of steel rods in water, $a = 3$ mm and $d = 2.5$ mm. Pressure distribution is shown at a frequency of 275 kHz [44].

Phononic crystal waveguide for SAW in holey silicon

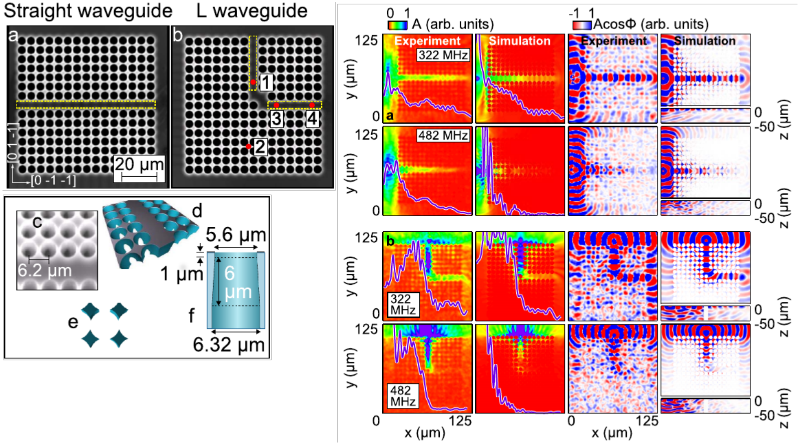


Figure: Time-domain optical pump-probe measurements [45]