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Acoustic wave band gaps in triangular and honeycomb
two-dimensional phononic crystals

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The ultrasonic band gap properties of phononic crystals composed of arrays of steel cylinders immersed in water and arranged according to square, triangular or honeycomb lattices are compared theoretically and experimentally. In all three cases, complete band gaps are obtained, and the conditions of existence are identified by observing the complete band gap width as a function of the size of the inclusions. However, the measured transmission spectra reveal in the hexagonal symmetry cases (triangular and honeycomb lattices) the existence of deaf bands that cause strong attenuation in the transmission, with no band gap being involved. Band gaps and deaf bands are identified by comparing band structure computations for the infinite phononic crystal, obtained by a periodic-boundary finite element method (FEM), with transmission simulations for the finite phononic crystal, obtained using the finite difference time domain (FDTD) method. The possibility of managing phononic wave guides within a defect line channel inside an otherwise perfect triangular lattice phononic crystal is further demonstrated experimentally.