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Design and characterization of stop-band filters using PZT layer on silicon substrate phononic crystals

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Phononic crystals are periodic structures exhibiting absolute band gaps i.e. frequency bands in which the propagation of elastic waves is forbidden in all directions. Filtering is then a possible application of phononic crystals. Recently, the existence of absolute band gaps has also been theoretically demonstrated for guided elastic waves in a piezoelectric plate on a substrate [J. Vasseur et al, J. Appl. Phys, 101, 114904, (2007)], which is a geometry of interest for possible co-integration on silicon chip. The 2D phononic crystal was constituted by a square arrangement of cylindrical holes in a PZT layer deposited on a silicon substrate. In this communication, the realization of a stop-band filter constituted by a periodically patterned PZT layer, polarized along thickness, on silicon substrate and interdigitated electrodes (IDE) for emission/reception of guided elastic waves, is investigated. The filter characteristics are theoretically evaluated by using finite element simulations: dispersion curves of patterned PZT layer are computed for various pattern geometries to obtain the absolute band gap. Complete structure is then modelled, with appropriate IDE to propagate a guided mode in the piezoelectric layer. Finally, filtering capability of the structure is evaluated. Work supported by STMicroelectronics (Nano2008 program of French ministry of industry).