6. Conclusion

In this work, we have theoretically investigated the possibilities to open phononic and photonic band gaps in silicon slabs drilled with circular air holes. This is totally new with respect to similar works performed in 2D infinite structures [22–24] since the existence conditions for the absolute phononic/photonic gaps are quite different in the case of a slab as compared to the case of a 2D infinite structure. We have studied both phononic and photonic band gaps in different lattices and found that simultaneous absolute band gaps can be obtained with the honeycomb lattice as well as in a small domain of the BN lattices close to honeycomb. Nevertheless, for all geometries (square, honeycomb and boron nitride lattices) the simultaneous confinement of both elastic and electromagnetic energy is possible, provided the incident wave is polarized. Of course, these results are independent of the scale of the structure. We have specified some numerical parameters by assuming that the optical wavelengths are in the range of telecommunication (wavelengths around 1550 nm). This leads to acoustic frequencies that fall in the gigahertz regime. Phononic and photonic crystal slabs hold promises for the simultaneous confinement and tailoring of sound and light waves with potential applications to acousto-optical devices and highly controllable photon-phonon interactions. Other properties such as linear and point defects will be investigated in subsequent works.

Table 1. ***Summary of the most suitable phononic and photonic crystals and the corresponding band gaps frequencies*.**

Array	α	f	r_i/a	h_{Si}/a	Phononic band gap	Photonic band gap odd modes	Photonic band gap even modes	Observations
Square	0	0.7	0.47	0.4	[0.439, 0.544]	[0.553, 0.658]		- Complete phononic and photonic gap - In the neighborhood of M - High value of f
Square	0	0.65	0.45	0.6	[0.472, 0.534]	[0.410, 0.495]	[0.361, 0.400]	- Photonic gap of a given symmetry only
Honey comb	1	0.45	0.249	0.48	[0.525, 0.626]	[0.434, 0.454]		- Complete phononic and photonic gap
Honey comb	1	0.45	0.249	0.7	[0.468, 0.611]	[0.368, 0.410]	/	- Photonic gap of an odd symmetry only
Honey comb	1	0.45	0.249	0.4	[0.503, 0.588]	/	[0.445, 0.492]	- Photonic gap of an even symmetry only
Boron Nitride Ex.	≥0.6 ≤0.8 0.6	≥0.4	r_1 = 0.181 r_2 = 0.302	≥0.5 0.5	[0.521, 0.602]	[0.390, 0.432]	[0.291, 0.343]	- Photonic gap of a given symmetry only

Acknowledgement

This work is supported in part by the European Commission Seventh Framework Programme (FP7) under the FET-Open project TAILPHOX N° 233833 and by Ministry of Higher Education and Research, Nord-Pas de Calais Regional Council and FEDER through the 'Contrat de Projets Etat Region (CPER) 2007-2013'.