Surface waves in porous silicon for nano-sensing applications

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Surface states in photonic crystals can be seen as the dielectric equivalents to surface plasmons. They have gained little attention so far, in spite of the very exciting phenomena related to them. In particular, combined with a material system such as porous silicon, they become very interesting for nano-sensing applications. In this paper, we present investigations of surface waves in porous-silicon based photonic crystals, following two different configurations: Surface waves in 1D and 2D photonic crystals.

The surface waves in 1D photonic crystals that appear at the surface of porous-silicon multilayers (so-called "Bragg mirrors") can be studied following methods similar to that used in plasmonics. Besides theoretical investigations, the fabrication process will be presented, as well as optical observations of these waves. In particular, we will show that they are very sensitive to the configuration of the surface layer, and discuss their application for nanosensing.

In the case of 2D photonic crystals, very peculiar phenomena related to the surface waves can be observed. We will discuss the behaviour of these modes depending on the surface termination, taking as an example the hexagonal lattice of air pores in porous silicon. We will propose as well an original way to observe these modes experimentally and to use them for sensing purposes.