Fano resonances in L3 photonic crystal slab cavities

J.P. Vasco[1,2], P.T. Valentim[1,2], H. Vinck-Posada[3], and P.S.S. Guimarães[1,2]

[1] *Departamento de Física, Universidade Federal de Minas Gerais, Belo Horizonte MG, Brazil.*

[2] *DISSE-INCT de Nanodispositivos Semicondutores, Brazil.*

[3] *Departamento de Física, Facultad de Ciencias, Universidad Nacional de Colombia - Sede Bogotá, Bogotá, Colombia.*

In the last two decades, semiconductor optics has been focused on building high efficiency and low loss devices for optoelectronic applications. The control of the dissipation channels is fundamental for this purpose and thus constitutes an important and active area of intense research. Semiconductor systems which present a spatially periodic dielectric function, known as photonic crystals, are optimal candidates for this purpose. Particularly, photonic crystal slab cavities show an interesting phenomena called Fano resonances, which are produced by the electromagnetic interference between the bounded states of the cavity and the external or scattering states through a dissipation channel, which is created by the finite thickness of the crystal. Therefore, changes of the lineshape of the Fano resonances reflect changes in the dissipation physical conditions. In this work we investigate the Fano resonances in two dimensional slab photonic crystal cavities of the type L3. These photonic crystals are fabricated on membranes of a semiconductor patterned with a periodic array of air holes. The actual cavity consists of three (L3) holes missing along one of the lines of the pattern. We calculate the Fano interference lines in the reflectivity through the scattering matrix method, with a defective periodic pattern described by a plane wave basis. The electric field inside and outside the structure is analyzed for a better understanding of the interference phenomenon. We find that the Fano lineshape can be tuned in a controllable way through the polarization of the incident field, which changes the effective phase between the two contributions to the interference. We show that for some polarizations angles the symmetry of the Fano resonance is reversed. A comparison with experimental data [1] on the reflectivity of photonic crystal cavities is also presented.

[1] P.T. Valentim, J.P. Vasco *et al.*, submitted for publication.