J Nanomater Mol Nanotechnol 2019, Volume 8
DOI: 10.4172/2324-8777-C3-063

Dispersion of ectromagnetic excitations in non-ideal lattices of coupled microcavities containing quantum dots

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Designing and utilization of novel materials for manufacturing of the sources of coherent irradiation is currently a vast interdisciplinary area, which spans various theoretical and fundamental aspects of laser physics, condensed matter physics, nanotechnology, chemistry as well information science [1,2]. Physical realization of corresponding devices requires the ability to manipulate the group velocity of propagation of electromagnetic pulses, which is accomplished by the use of the so-called polaritonic crystals [3-5]. The latter represent a particular type of photonic crystals featured by a strong coupling between quantum excitations in a medium (excitons) and optical fields. We considered 1D and 2D polaritonic crystal as a topologically ordered systems – array of coupled microcavities containing quantum dots. It is of substantial interest to investigate electromagnetic excitations in a non-ideal one-dimensional microcavity lattice subjected to a uniform elastic stress. The one-sublattice array of identical cavities contains randomly embedded quantum dots of two types. Moreover, these microcavity-resonators are also randomly removed at distances between the nearest neighbors. In order to calculate polaritonic spectrum of such a system we shall adopt the virtual crystal approximation, which is based on diagonalization of the averaged Hamiltonian [6]. The peculiarities of polariton spectrum in the 1D and 2D lattices of microcavities caused by the presence of the structure defects and uniform elastic deformation of the micropores array with quantum dots are studied. The presence of deformation and of structural defects may lead to an increase of the effective mass of corresponding excitations and therefore to a decrease of their group velocity. The results of numerical calculation performed on the basis of the constructed model contribute to modeling of the new class of functional materials – photonic crystalline system constituted of couple microcavities.

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