Vladimir V Rumyantsev, J Material Sci Eng 2017, 6:7 (Suppl)
DOI: 10.4172/2169-0022-C1-080

Effect of elastic deformation on the dispersion characteristics of a polaritonic crystal

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Concepts developed in physics of crystalline solids prove to a large extend applicable to photonic supercrystals. In this connection some promising vistas can be opened by the so-called polaritonic crystals, which represent a particular type of photonic crystals featured by a strong coupling between quantum excitations (excitons) and electromagnetic waves. An example of polaritonic structure is provided by an array of coupled microcavities. Optical modes in microcavity systems have been attracting a considerable attention due to the progress in fabrication of novel optoelectronic devices. Of considerable interest are the works associated with the ability to control the propagation of electromagnetic excitations in the composite structures with modification of their physical properties as a result of external influences (for example, elastic deformation). In the present paper we use the previously developed concepts of photonic structures to treat a nonideal polaritonic crystal formed by a topologically ordered array of coupled microcavities (resonators) containing a system of atomic clusters (quantum dots). Particular attention is paid to the sensitivity of the polaritonic spectrum on the geometry and key parameters of interacting photonic and electronic subsystems. We considered 2D polaritonic crystal as a topologically ordered system of coupled microcavities containing quantum dots. The peculiarities of polariton spectrum in the two-dimensional lattice of microcavities caused by uniform elastic deformation of the structure is considered. It is shown that as a result of elastic deformation of the system it is possible to achieve the necessary changes of its energy structure and optical properties caused by the restructuring of the polariton spectrum.

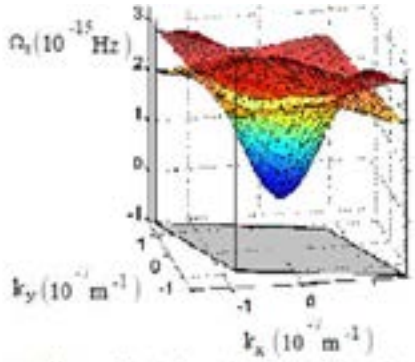

Figure 1: Effects of the deformation of 2D lattice of microresonators (a darkened area within the parallelogram corresponds to the first Brillouin zone) on the polaritons dispersion function $\Omega(\vec{k})$, $\nu = z$, for components of the strain tensor which are equal to $\varepsilon_{xx} = \varepsilon_{yy} = 0.1; \varepsilon_{xy} = 0.3$

Biography

Vladimir V Rumyantsev is Head of Department of Theory of Complex Systems Dynamic Properties at A.A. Galkin Donetsk Institute for Physics and Engineering (DonIPE). He is Professor of Theoretical Physics and Nanotechnology Department at Donetsk National University (DonNU). He received PhD in Theoretical Physics (1988) from Don-NU and Dr. Sci. in Condensed Matter Physics (2007) from DonIPE. Prof. Rumyantsev has authored/co-authored 4 books, 2 chapters in books and more than 230 scientific publications. He is a member of the American Physical Society as well as Mediterranean Institute of Fundamental Physics (MIFP, Italy) and Editor-in-Chiff of Journal of Photonic Materials and Technology (Science PG, USA).

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