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Light-matter coupling in imperfect superlattice of coupled microresonators

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The important features of photonic band-gap structures under discussion are connected with 'slow' light, which is one of the promising fundamental physical phenomena that can be explored in the design of various quantum optical storage devices. In particular, the effective reduction of the group velocity demonstrated in the associated optical waveguide resonators. Key role in reducing the group velocity in these systems is played by so-called light and dark polaritons, which are linear superposition of photon states of the external electromagnetic field and the macroscopic (coherent) perturbations of two-level atomic medium. Based on the representations of the ideal photonic structures, the non-ideal systems of this class - polaritonic crystal, which is a set of spatially ordered cavities containing atomic clusters, is considered. Moreover, the spatial distribution of cavities (resonators) is translation invariant, and the atomic subsystem has randomly distributed defects: Impurity atomic clusters (quantum dots) or a vacancies. Numerical modeling of dependence of the dispersion of polaritons in this imperfect lattice of associated microresonators on impurity concentration is completed. Using the virtual crystal approximation the analytical expressions for polaritonic frequencies, effective mass and group velocities, as a function of corresponding quantum dots and vacancies concentrations, is obtained. It turned out that even with a small number of vacancies in the lattice (one position for a thousand resonators) weight polaritons increases by three orders of magnitude. These results enable to extend the possibility of creating a new class of functional materials - polaritonic crystal systems.

Biography

Vladimir V Rumyantsev is Professor in Nanophysics Department at Donetsk National University (DonNU) and Head of Physics Technology Subdivision at A.A. Galkin Donetsk Physico-Technical Institute of National Academy of Sciences of Ukraine (DonPhTI NANU). He received PhD in Physics (1988) from DonNU and Dr. Sci. in Solid State Physics (2007) from DonPhTI NANU. He has published more than 200 scientific publications. He is Co-coordinator of joint Russian-Ukrainian project (2012-2013) and Group Leader of International project in the framework of the European program FP7-PEOPLE-2013-IRSES (2013-2016).

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