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Effects of strain on spectrum of electromagnetic excitations in 1D nonideal photonic structure such as a chain of microcavities

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Photonic structures and metamaterials are in the focus of theoretical and experimental interdisciplinary studies, which span laser physics, condensed matter physics, nanotechnology, and information science. 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. 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 microcavities containing ultracold atomic clusters, is studied. We considered 1D polaritonic crystal as a topologically ordered system of coupled microcavities containing quantum dots. The peculiarities of polariton spectrum in the 1D 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. Numerical modeling of dependence of the dispersion of polaritons in this lattice of associated microresonators on an elastic deformation is completed. Using the virtual crystal approximation the analytical expressions for polaritonic frequencies, effective mass and group velocities, as a function of components of the strain tensor is obtained. These results enable to extend the possibility of creating a new functional material - polaritonic supercrystal as array of coupled microcavities under strain.