Tunable Local Polariton Modes in Semiconductors

M. Foygel,[1,2] Alexey Yamilov,[1] Lev I. Deych,[3] and Alexander A. Lisyansky[1]

[1]Department of Physics, Queens College of CUNY, Flushing, NY 11367
[2]Department of Physics, South Dakota School Mines and Technology, Rapid City, SD 57701
[3]Department of Physics, Seton Hall University, South Orange, NJ 07079

It has been shown in a number of recent papers [1] that point defects (impurities) in certain polar crystals can produce local vibrational states in the region between TO and LO phonons (Restrahlen region). Because the dielectric function of the host material is negative in this spectral region the interaction between the local modes and retarded electromagnetic field leads to creation of new type of local states - local polaritons. In the case of finite concentration of the defects local polaritons develop into an impure polariton band [2]. In this paper we study the local polaritons formed by deep defect centers with strong electron-phonon coupling. The main idea of the paper is to demonstrate that this type of defects can be used to create tunable local polariton states. The tuning is based upon the fact that electron transitions involving deep levels may result in controllable alteration of local elastic constants, as was demonstrated for O_P centers in GaP [3]. In this case, substantial reversible transformations of the impurity polariton density of states occur, which include an appearance/disappearance of the polariton impurity band, its shift and/or a modification of its shape. These changes can be induced by thermo- and photo-excitation of the localized electron states or by trapping of injected charge carriers. Possible experimental realizations of this effect are discussed.

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