Proceedings of the 5th International Conference on Nanotechnology: Fundamentals and Applications
Prague, Czech Republic,August 11-13, 2014
Paper No. 295

Phonon Mediated Optical Stark Effect for Inorganic-organic Hybrid Heterostructures

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Extended Abstract

Phonon mediated optical Stark effect for organic-semiconductor heterostructures (the quantum well, the system of quantum dots) with existence of hybrid Wannier-Frenkel excitons will be studied theoretically and modelled numerically, taking into account in the macroscopic phonoriton equations the two-component exciton state. The phonoriton quasi-eigenstate, which have been introduced theoretically (Ivanov, Keldysh, 1983) and observed experimentally (Hanke et al., 1999), characterises a coherent superposition of exciton, photon and photon. The spectrum arises from mutual hybridization and unification of the initial excitonic polariton and phonon dispersion.

Wannier-Frenkel hybrid exciton state, which exists at the interface of organic-inorganic systems, has optical and electronic properties greatly different from both Wannier and Frenkel excitons and can overcome the limitation of each kind of excitons. A hybrid Wannier-Frenkel exciton is currently considered as one of the most promising electronic states that can be implemented in optoelectronic devices of a new generation.

The system of macroscopic equations of hybrid excitons, photons and phonon is investigated in order to model the optical Stark effect for the hybrid systems with combination of semiconductor and organic materials. While the Frenkel exciton component has a strong coupling with the light field (polariton effect), the Wannier exciton component can strongly interact with phonons. The combination of these two components will enhance the formation of phonoritons. Because hy brid excitons can be pre-designed, by varying the Wannier-Mott and Frenkel components, the room-temperature PMOSE will be numerically optimised aiming to minimise operating optical intensity.

The unique properties of the hybrid system will allow tuning the system to get the most preferable outcomes. One of the key points is to study the interaction of different components of the system with each other to get the condition to facilitate the observation of phonoriton and the phonon-mediated Stark effect.

References

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