Nanooptics and photonics

Exciton and biexciton states in nanoheterostructures of semiconductor and dielectric quantum dots

S.I. Pokutnyi [1]

[1] *Chuiko Institute of Surface Chemistry, Natl. Acad. of Sci. of Ukraine. General Naumov str., 17, Kyiv-03164, Ukraine.*
E-mail: pokutnyi_sergey@inbox.ru

The Ge/Si heterostructures promising to create new elements silicon infrared optoelectronics are self-assembled structures with Ge/Si nanoislands [1]. Ge/Si heterostructures with quantum dots (QDs) of Ge are heterostructures II type. In this nanosystem the lowest electronic level is in matrix, and the lowest hole level is within volume of QD. The electrons move in the matrix and do not penetrate in the volume of QD. During investigation of the optical properties of heterostructures Ge/Si with Ge QDs in experimental papers it was found that the electron can be localized above the surface of the QD while the hole here moves in the volume of the QD. Using the method of electron-beam lithography obtained heterostructures which are linear chains of QDs germanium on Si substrates. The average sizes of the QD Ge is less than 60 nm. It was noted that, at such a QD content in the samples, one must take into account the interaction between charge carriers localized above the QD surfaces. In [1], the theory of an exciton formed by spatially separated electron and hole is developed (the hole moves in the bulk of a Ge QD and the electron is localized above the spherical interface between the QD and the Si matrix). It was found that the binding energy of an exciton in such nanosystem is much higner (almost an order of magnitude) than the binding energy of an exciton in a Si single crystal. A theory of exciton quasimolequle (formed from spatially separated electrons and holes) in nanosystems that consist of germanium quantum dots synthesized in a silicon matrices is developed [2]. It was found that the binding energy of singlet ground state of exciton quasi - molecule, consisting of two germanium quantum dots is a significant large values, larger than the binding energy of the biexciton in a silicon single crystal by almost two order of magnitude.

1. *Pokutnyi S.I.* Excitons based on spatially separated electrons and holes in Ge/Si heterostructures with germanium quantum dots // Low Temp. Phys.-2016.- **42**. **–**P.1151 **–** 1154.
2. *Pokutnyi S.I.* Biexciton in nanoheterostructures of dielectric quantum dots // J. Nanophoton. 2016.-**10**. **–**P.1151 **–** 1154.