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Exciton and biexciton states in quasi-zero-dimensional nanosystems: Theory

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We developed within the modified effective mass method the theory of an exciton formed from spatially separated electron and hole (the hole is in the semiconductor spherical quantum dot (QD)) volume and the electron is localized at the outer spherical surface of the QD-matrix interface. The effect of significantly increasing the binding energy of an exciton in a nanosystem containing ZnSe QDs in comparison with the binding energy of an exciton in a ZnSe single crystal (by a contribution factor of 73) was detected. It was shown that nanosystems consisting of ZnSe QDs grown in a borosilicate glass matrix can be used as the active region of semiconductor QD lasers. We developed the theory of a biexciton formed from spatially separated electrons and holes (the hole is in QD volume, and the electron is localized at the outer surface of the QD-matrix interface) in a nanosystem that consists of ZnSe QDs synthesized in a glassy matrix. It is shown that the major contribution to the biexciton binding energy is made by the energy of the exchange interaction of electrons with holes and this contribution is much more substantial than the contribution of the energy of Coulomb interaction between the electrons and holes. It is established that the spectral shift of the peak in such QDs is due to quantum confinement of the energy of the biexciton ground state.

Biography

Sergey I Pokutnyi is Professor of Theoretical Physics, Doctor of Sciences (Physics, Mathematics) (1994, Institute of Spectroscopy Russian Academy of Sciences). He is leading Researcher Chuiko Institute of Surface Chemistry of National Academy of Sciences of Ukraine. He has published more than 220 papers (8 monographs) and has been serving as an editorial board member of journals: *Journal of Nanosciences Letters and Physics Express* (2010-2012); *Journal of Optics* (2013), *Journal of Applied Chemistry* (2013), *Journal of Modern Physics* (2013), *Journal of Theoretical Physics* (2013), Editor of Nova book "Advances in Semiconductor Research" (2014).

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