LUMINESCENCE AND ENERGY RELAXATION OF LOCALIZED EXCITONS IN CdS QUANTUM DOTS GROWN IN A LOW-PERMITTIVITY MATRIX

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S u m m a r y

The results of our researches of borosilicate glasses with CdS quantum dots (QDs), the dimensions of which are smaller than the exciton Bohr radius, are reported. The mean size of quantum dots for a given CdS concentration has been calculated in the effective mass approximation, the result obtained being in good agreement with X-ray data. In the same approximation, the exciton binding energy has also been calculated, with and without the dielectric mismatch between the semiconductor and the matrix being taken into account. Two channels of radiative recombination associated with the annihilation of excitons in quantum-mechanical and surface (localized) states have been shown to exist in such QDs, and the efficiency of exciton relaxation between those channels has been demonstrated to depend on the QD size. For the first time, a photoluminescence (PL) band has been found for specimens excited in the long-wave range of their absorption spectrum; the band is due to the recombination of excitons in localized states, and its characteristic properties are typical of other disordered structures. A conclusion has been drawn about a universal character of both the energy relaxation process and the PL band shape for excitons localized at QDs and quantum wells (superlattices) with a disorder that are located at heterointerfaces, as well as in amorphous semiconductors and solid solutions.