Substrate and Luminescence properties of CdSe/CdS/ZnS Quantum Dots

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The photoluminescence of CdSe/CdS/ZnS quantum dots (QDs) deposited at solid surfaces (ITO) is considered for three types of organization: QDs directly adsorbed on solid surfaces, separated from the solid surface by a nanoscale liquid crystal (8CB) film with different thickness.

The luminescence spectra were obtained at different film irradiation times. Irradiation was performed by a laser with a wavelength of 473 nm in a pulsed mode and an optical power of 10 mW. The laser spot diameter was about 300 nm, and the exposure time was 1 s. It is noticeable that with an increase in the duration of exposure to laser radiation on the film, the value of the maximum luminescence intensity decreases. Figure 1, shows a typical series of spectra (54 s duration) for a CdSe/CdSe/ZnS QD film. At the beginning, the emission peak falls at ~528.9 nm, and then shifts slightly to the blue region. After 54 seconds of exposure, this shift is about 6.7, 5.6 and 4.3 nm, and its intensity decreases by 85.9, 62.7 and 50% for the systems (QDs), (QDs + 8CB monolayer) and (QDs+ 8CB three-layer film), respectively.

The curve can be conditionally divided into two components, describing the "fast" and "slow" components of the decline. These individual parameters can be extracted by describing it with a two-term exponential relationship:

$$I(t) = A_1 \exp\left(-t/T_1\right) + A_2 \exp\left(-t/T_2\right),$$

where I(t) is the luminescence intensity, A_1 and A_2 are constants (amplitudes), T_1 and T_2 are constants representing the lifetime in the fast and slow processes, t is the laser exposure time (seconds). The estimation of the components T1 and T2 by the selection method made it possible to estimate the decay rate ($\beta = 1/T$) for the fast and slow process.

It was shown that the luminescence properties of thin QD films on a ITO surface can be tuned by adding a nanosized 8CB film (about 6 nm thick) between the QD layer and the substrate. It can be seen that the luminescence peak shifts hypsochromically to the blue region during irradiation. It was found that the luminescence intensity decreased by 35%.

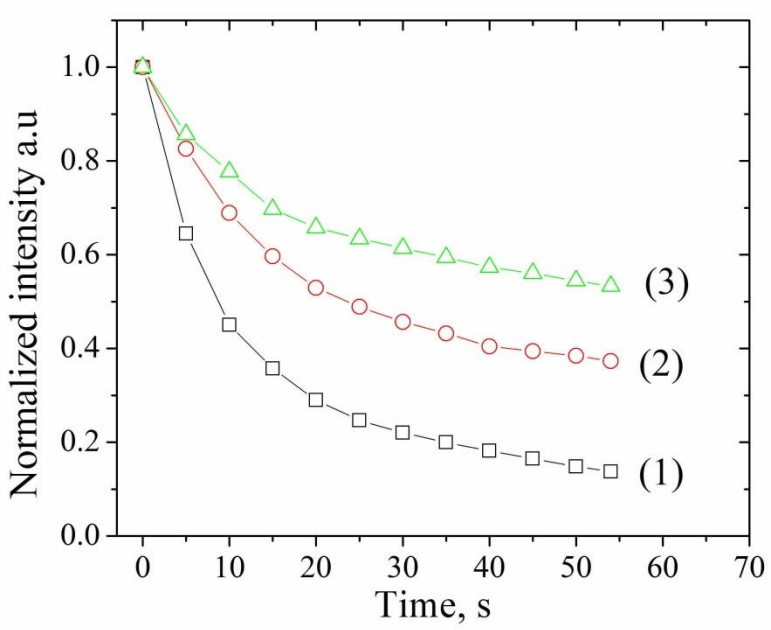

Figure 1 - Change in the intensity of the luminescence maximum depending on the irradiation time of the film QDs (1), QDs + 8CB monolayer (2) and QDs + 8CB three-layer film (3).

Acknowledgments

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