On the Spectroscopic Method of Measuring the Size of the CdSe Nanocristals

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Keywords: *quantum dot, energy spectrum, luminescence, absorption.*

Abstract

The dependences of the energy E of the fundamental transition in CdSe quantum dots versus parameter $x = 10^4/a^2$, which depends on the quantum dot radius a, are analyzed and compared on the basis of the published experimental data [1-5]. The experimental results obtained by the same research team at 10 K presented in [1,2] lead to substantially different dependences $E_1(x)$ and $E_2(x)$, respectively (see Fig. 1). It is easy to see that the curve $E_2(x/4)$ shifted along the vertical line for a certain distance with high accuracy coincides with the curve $E_1(x)$. This coincidence suggests that though everywhere in [2] the concept of quantum dot radius a is used, the dot's diameter $d = 2a$ is actually assumed.

The fact that the measurements performed in [3] at 300 K lead to the $E_3(x)$ dependence, which coincides with the $E_1(x)$ dependence shifted upward by 90 *meV*, confirms that the $E_1(x)$ curve is correct. The forbidden gap of CdSe bulk crystals amounts to 1.84 *eV* for 10 K and 1.75 *eV* for 300 K. Therefore, the equation $E_3(x) - 1.84\ eV \approx E_1(x) - 1.75\ eV$ shows that it is possible to extrapolate the spectroscopic results obtained at a certain temperature to the case of other temperature values simply by taking into consideration the temperature dependence of the forbidden gap of the bulk semiconductor.

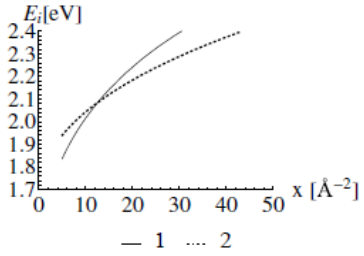

Fig. 1

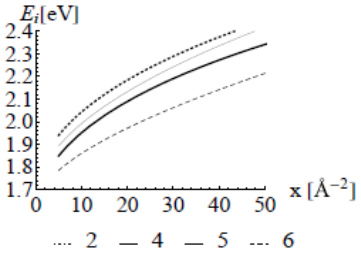

Fig. 2

The dependences of the fundamental transition energy in CdSe quantum dots versus their size at 300 K (Fig. 2) can be obtained form the results also published in [4,5]. The first one leads to the curve $E_4(x)$ located above $E_3(x)$, the second is presented by the curve $E_5(x)$ located below $E_3(x)$. The curves $E_4(x) - 50\ meV$ and $E_5(1.3x) + 50\ meV$ nearly coincide and are close to the curve $E_1(x)$. The divergence of the results published in [4] and [5] appears, probably, since the quantum dot radius in [5] by a factor of 0.9 differs from the value assumed by the authors.

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