Optical properties of thin film of CdSe/CdS/ZnS quantum dots capped with oleic acid

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The formed monolayer and deposited thin film of CdSe/CdS/ZnS quantum dots on silicon substrate was prepared using Langmuir Blodgett method. The optical properties of CdSe/CdS/ZnS quantum dots capped with oleic acid (OA) were studied using PL spectra, determination using the NT-MDT Ntegra Spectra nanolaboratory (Russia), luminescence (PL) was excited by a laser with a wavelength of 473 nm and an optical power of 10 mW. The laser spot diameter is about 300 nm, the exposure time is 1 s. The spectral resolution is 0.33 nm. The intensity of the PL growth peak increases by more than 4 times after the solution is heated to 60 ^{o}C and purified from excess surfactants of oleic acid (Fig.1 peak “b”). In this case, a blue shift takes place in the PL peak by several nanometers. The observed “blue shift” of the PL peak after purification can be explained by a changing in the shell thickness of quantum dots during the removal of excess oleic acid.

The core-shell-shell system of CdSe/CdS/ZnS QDs demonstrates two different PL emission peaks due to core and shell emission. Thus, the shells of CdSe/CdS/ZnS QDs act as two quantum barriers, and by adjusting their thickness, one can influence the luminescence intensity of QDs [1]. The application of heating to the QD solution affects the shell thickness, which leads to a shift in one of the characteristic PL peaks.

A slight shift of the maximum of the QD emission spectrum (change in peak width, FWHM) after separation can be explained by the effect of heating, which affects the outer shell of the QD, leading to a change in the state of the QD surface.

The separation of excess oleic acid from quantum dots solution leads to the morphology of the films improved significantly (distance between particles, roughness). The cleaned films also demonstrate a high level of photosensitivity and photoresponse, which may allow their use in photovoltaic devices.

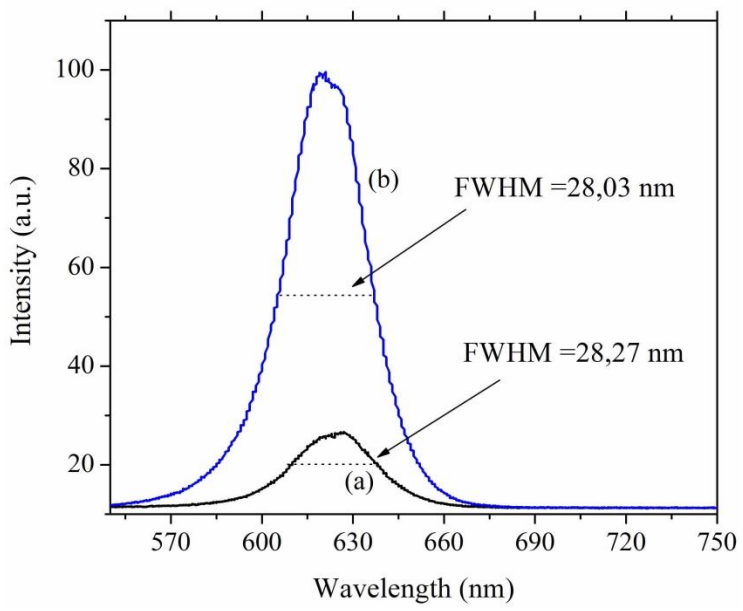

Fig. 1 PL spectra of QD thin film before separation of oleic acid (a) and after (b).

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References

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