

Bioconjugation and Modification of Raman spectra of CdSe/ZnS quantum dots

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Semiconductor nanometer-scale CdSe/ZnS core/shell quantum dots (QDs) with the high intensity of photoluminescence (PL) could dramatically improve the use of fluorescent markers in biological imaging. They can provide distinct advantages over in vitro and in vivo markers (organic dyes and fluorescent proteins). It is important to look for other optics effects of the QDs which can offer additional information on the structure of bio-conjugated QDs.

This paper presents the results of the analysis of Raman scattering spectra of CdSe/ZnS QDs. The commercially available core-shell CdSe/ZnS QDs covered with a PEG polymer were used in a form of colloidal particles diluted in a phosphate buffer (PBS) with a 1:200 volumetric ratio. Studied QDs are characterized by the size of 5.2 nm and color emission with the maxima at 605-610 nm (2.03-2.05 eV). The part of CdSe/ZnS QDs has been conjugated to the antihuman Interleukin (IL10) antibodies using the commercially available 605 nm QD conjugation kit. Samples of CdSe/ZnS QDs (bio-conjugated and non-conjugated) in the form of 5 mm-size spots were dried on a polished surface of crystalline Si substrate to ensure a low level of light scattering background. Raman scattering spectra were measured at room temperature by micro Raman spectrometer using a He-Ne laser (632.8 nm) as an excitation source with a power of 20 mW in backscattering configuration.

Raman scattering spectra of non-conjugated QDs can be presented as a superposition of Raman lines: 212.2, 222.5, 232.22, 308.3, 440.3, 618.0, 667.8 cm⁻¹ related to the core/shell CdSe/ZnS quantum dots and to the Si substrate (521.0 cm⁻¹), as well as the Raman lines 943.5, 986.7, 1013.9, 1057, 1118, 1136, 1227, 1275, 1330, 1350, 1437, 1460, 1620, 1656, 2870.4, 2931.8 and 3059.9 and 3310 cm⁻¹ deal with the vibration of COH, CH₂ CH and OH groups of polymer, which cover of QDs. It is revealed that the QD bio-conjugation to the anti IL10 mab is accompanied with the changes dramatically in the intensity of both types of Raman lines: related to CdSe/ZnS core/shell and polymer groups. The explanation of bio-conjugation effects has been proposed and discussed. The comparison of Raman spectra of CdSe/ZnS QDs in non-conjugated and bio-conjugated states gives opportunity to detect the bio-conjugation without mistake.

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