

Cadmium Telluride Quantum Dots (CdTe QDs)-Thymine Conjugate Based Fluorescence Biosensor for Sensitive Determination of Nucleobases/Nucleosides

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Abstract : The analysis of nucleobases is of great importance for bioscience since their abnormal concentration in body fluids suggests the deficiency and mutation of the immune system, and it is considered to be an important parameter for diagnosis of various diseases. The presented conjugate meets the need for development of the effective, selective and highly sensitive sensor for nucleobase/nucleoside detection. The novel, highly fluorescent cadmium telluride quantum dots (CdTe QDs) functionalized with thymine and stabilized with thioglycolic acid (TGA) conjugates has been developed and thoroughly characterized. Successful formation of the material was confirmed by elemental analysis, and UV-Vis fluorescence and FTIR spectroscopies. The crystalline structure of the obtained product was characterized with X-ray diffraction (XRD) method. The composition of CdTe QDs and their thymine conjugate was also examined using X-ray photoelectron spectroscopy (XPS). The size of the CdTe-thymine was 3-6 nm as demonstrated using atomic force microscopy (AFM) and high resolution transmission electron microscopy (HRTEM) imaging. The plasmon resonance fluorescence band at 540 nm on excitation at 351 nm was observed for these nanoparticles. The intensity of this band increased with the increase in the amount of conjugated thymine with no shift in its position. Based on the fluorescence measurements, it was found that the CdTe-thymine conjugate interacted efficiently and selectively not only with adenine, a nucleobase complementary to thymine, but also with nucleosides and adenine-containing modified nucleosides, i.e., 5'-deoxy-5'-(methylthio)adenosine (MTA) and 2'-O-methyladenosine, the urinary tumor markers which allow monitoring of the disease progression. The applicability of the CdTe-thymine sensor for the real sample analysis was also investigated in simulated urine conditions. High sensitivity and selectivity of CdTe-thymine fluorescence towards adenine, adenosine and modified adenosine suggest that obtained conjugate can be potentially useful for development of the biosensor for complementary nucleobase/nucleoside detection.

Keywords : CdTe quantum dots, conjugate, sensor, thymine

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