A Single Dual-Emissive Nanoprobe for Quantification of Spontaneous Glucose in Human Serum

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ABSTRACT

In this work, we report a strategy of a single dual-emissive ratiometric fluorescent nanoprobe (QDs@SiO_2-CDs) with the controllable ratio of emissive intensities to realize the consecutive color variations from blue to red for the quantification of blood glucose. The red quantum dots (rQDs) were embedded into silica nanoparticles (SiO_2 NPs) as an stable internal standard emission, and blue carbon dots (bCDs) were further covalently linked onto the surface of SiO_2 NPs, in which the ratiometric fluorescence intensity of blue to red is controlled at 5:1. When the oxidation of glucose induced the formation of Fe^{3+} ions, the fluorescent intensity (at 445 nm) of bCDs (from QDs@SiO_2-CDs) was thus quenched by the electron transfer from CDs to Fe^{3+}. Meanwhile, the fluorescent intensity (at 630 nm) of rQDs (from QDs@SiO_2-CDs) keeps almost unchanged. It has been demonstrated that the fluorescence intensity ratio I_{445}/I_{630} is linearly related to the glucose concentration in the range of 0−75 μM (R^2 = 0.989). The calculated detection limit is about 3 μM in terms of the 3σ rule. Consecutive color variations from blue to red with the dosage of glucose can be seen under a 365 nm UV lamp. That is to say, the ratiometric fluorescent probe can be used for the detection of glucose in human serum. The test result show that the spontaneous blood glucose determined by the probe was almost in accordance with that measured by a standard glucometer. The method reported here opens a window to the wide applications of the ratiometric fluorescent probe in biological assays.