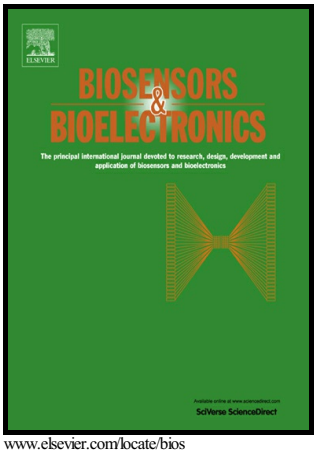

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ABSTRACT

In this paper, a nanostructured biosensor is developed to detect glucose in tear by using fluorescence resonance energy transfer (FRET) quenching mechanism. The designed FRET pair， including the donor, CdSe/ZnS quantum dots (QDs), and the acceptor, dextran-binding malachite green (MG-dextran), was conjugated to concanavalin A (Con A), an enzyme with specific affinity to glucose. In the presence of glucose, the quenched emission of QDs through the FRET mechanism is restored by displacing the dextran from Con A. To have a dual-modulation sensor for convenient and accurate detection, the nanostructured FRET sensors were assembled onto a patterned ZnO nanorod array deposited on the synthetic silicone hydrogel. Consequently, the concentration of glucose detected by the patterned sensor can be converted to fluorescence spectra with high signal-to-noise ratio and calibrated image pixel value. The photoluminescence intensity of the patterned FRET sensor increases linearly with increasing concentration of glucose from 0.03 mmol/L to 3 mmol/L, which covers the range of tear glucose levels for both diabetics and healthy subjects. Meanwhile, the calibrated values of pixel intensities of the fluorescence images captured by a handhold fluorescence microscope increases with increasing glucose. Four male Sprague-Dawley rats with different blood glucose concentrations were utilized to demonstrate the quick response of the patterned FRET sensor to 2 μL of tear samples.

Keywords: Fluorescence resonance energy transfer (FRET); quantum dots; silicone hydrogel; tear glucose; non-invasive biosensor

[1] L. Y. Chen and W.H. Tse contributed equally