

Enzymatic Growth of Quantum Dots: Applications to Probe Glucose Oxidase and Horseradish Peroxidase and Sense Glucose

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Abstract

Quantum Dots (QDs) have been generally used as fluorescent labels in biosensing, especially in assays based on detection of analytes by affinity binding. The background signal of these bioanalytical systems is quite high due to nonspecific adsorption of decorated QDs on surfaces or poor quenching of a donor couple. Enzymatic growth of QDs *in situ* triggered by a biorecognition event potentially can solve the problem of the high background signal, improve sensitivity and diminish costs of analytical assays and could use a much more sensitive fluorescence spectroscopy.

We developed three innovative assays to detect enzymatic activities of glucose oxidase (GOx) and horseradish peroxidase (HRP) by generation of CdS QDs *in situ* using non-conventional enzymatic reactions. In the first assay GOx catalyzes the oxidation of 1-thio- β -D-glucose to give 1-thio- β -D-gluconic acid. The latter is spontaneously hydrolyzed to β -D-gluconic acid and H₂S, which in the presence of cadmium nitrate yields fluorescent CdS nanoparticles. In the second assay HRP catalyzes the oxidation of sodium thiosulfate with hydrogen peroxide generating H₂S and consequently CdS QDs. The combination of GOx with HRP, allowed quantification of glucose in plasma by following growth of fluorescent QDs. These systems can provide models for numerous peroxidase and oxidase-based biosensor assemblies.

Scheme 1. Enzymatic generation of CdS QDs for the detection of redox enzymes.

