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Effect of biocatalytic reactions on growth of semiconductor nanoparticles: Application to biosensing**Valery Pavlov**

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Our laboratory discovered for the first time that products of enzymatic reactions are able to modulate growth of semiconductor fluorescent CdS nanoparticles (NPs) grown in situ. Emission spectra of these NPs depend on their size and capping agents which stabilize them in aqueous solutions. We found out experimental conditions under which the growth of CdS NPs is very rapid and takes 10 min or less. The biocatalytic growth of CdS NPs has been applied to optical determination of enzymatic activities of enzymes such as acetylcholine esterase,¹ horseradish peroxidase,² glucose oxidase³ etc. We also reported novel sensitive selective electrochemical assays based on generation of CdS NPs in situ which is modulated by affinity interactions and oxidative activity of metal ions. For example, our immunoassay employs antibody-alkaline phosphatase conjugate which catalyzes generation of CdS detected with disposable carbon electrodes premodified with the electroconductive polymer Os-PVP.⁴ We demonstrated a new electrochemical assay employing microbead linked enzymatic generation of CdS QDs (Microbead QD-ELISA)⁵ for cancer marker superoxide dismutase. In the presence of this analyte, CdS NPs were formed on the surface of microbeads modified with antibodies for superoxide dismutase (Figure 1). Formed in situ CdS NPs were followed with fluorescence spectroscopy, microscopy, and square-wave voltammetry. Our latest assays use cysteine (CSH) which stabilizes CdS NPs growing during the biorecognition event in aqueous buffered solutions. Oxidation of CSH with hydrogen peroxide (H₂O₂) results in formation of cystine (CSSC) which does not stabilize CdS NPs. A number of chemical and biochemical reactions involving copper ions, glucose⁶ and methanol yield hydrogen peroxide, modulating the quantity of CdS NPs produced in situ.

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