Enzymatic Electrochemical Detection of Hydrogen Peroxide Using Carbon Nano-Structures

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Abstract

Hydrogen peroxide (H_2O_2) is a well-known oxidant and an important substance for many environmental and medical applications. Therefore, the detection of H_2O_2 from environmental samples and biological fluids can be important for monitoring environmental quality and effects of several diseases, respectively. Several different detection mechanisms have been reported in the literature for the detection of H_2O_2 including spectrometric, chromatographic and electrochemical. Among all these methodologies, electrochemical methods stand out because they can provide high sensitivity, reproducibility and simplicity. Enzymatic detection of H_2O_2 using electrochemical methods would also provide very high selectivity. The most widely used enzyme for the detection of H_2O_2 is horseradish peroxidase (HRP) due to providing direct electron transfer mechanism which makes the biosensor construction steps less complicated. In this work, a simple immobilization of HRP was performed on carbon nano-structured screen-printed electrodes (SPEs) and sensitive detection of H_2O_2 was then achieved at physiological conditions. Modified SPEs were first electrochemically optimized and obtained films showed good stability and linearity with increased material loading. The successful immobilization of the HRP was then achieved on modified SPEs. Finally, the enzymatic detection of H_2O_2 was successfully achieved using electrochemical methods. The constructed biosensor showed a reproducible linear response to varying amounts of H_2O_2 and low cross-interference for the substances tested. The constructed biosensor could pave the way forward for both environmental and medical H_2O_2 screening applications.

Keywords: biosensor; enzyme immobilization; horseradish peroxide; hydrogen peroxide; screen-printed electrode