

Abstract

A Comparative Study between Hydrogen Peroxide Amperometric Biosensors Based on Different Peroxidases Wired by Os-Polymer: Applications in Water, Milk and Human Urine [†]

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In the last few years, hydrogen peroxide (H₂O₂) real-time monitoring has attracted great interest due to its large employment in industrial processes: in particular, H₂O₂ is released into the environment in small or large amounts, since it is used as an oxidant, bleaching and sterilizing agent [1]. Recently, H₂O₂ has been found as a valuable biomarker present in human urine which may elucidate specific levels of oxidative stress in vivo [2].

A comparison has been made between two plant peroxidases, cationic horseradish peroxidase (HRP) and anionic tobacco peroxidase (TOP) [3], wired by a cationic osmium polymer ([Os(dmp)PVI]⁺²⁺) [4,5] to prepare highly sensitive, stable and selective hydrogen peroxide biosensors. HRP and TOP peroxidases were immobilized onto graphite rod (G) electrodes by a simple drop-casting procedure using a solution of poly(ethyleneglycol) diglycidyl ether (PEGDGE), as cross linking agent.

Cyclic voltammetry experiments were carried out in order to investigate the influence of the charge of the enzyme and the polymer on the efficiency of the electron transfer (ET) between the enzyme and the wiring redox polymer and the efficiency of the electrocatalytic reduction of H₂O₂. TOP modified electrode showed an enhanced ET rate due to the attraction between the anionic enzyme and the cationic Os-polymer. pH influence, stability and selectivity of both biosensors were carefully investigated. Both peroxidase modified biosensors exhibited a wide linear range (1–500 mM H₂O₂) and a low detection limit (0.3 mM H₂O₂). TOP based electrode showed a higher sensitivity (467.4 nA μM⁻¹ cm⁻²), a higher catalytic constant (63.5 s⁻¹), a lower K_{M^{app}} (302 mM) and an improved long-term stability (current decrease of 17.3% upon 30 days) compared to HRP.

Both HRP and TOP based biosensors were successfully tested in real samples of contact lens cleaning solutions and in real “spiked” samples of water, milk, dairy products and human urine.

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