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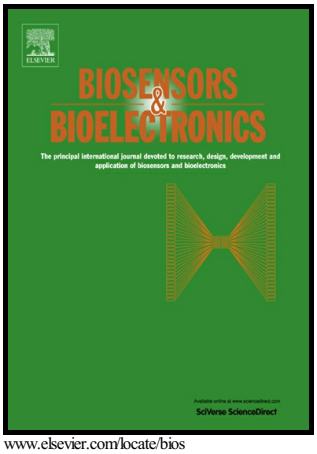

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Functionalized polyacrylamide as an acetylcholinesterase-inspired biomimetic device for electrochemical sensing of organophosphorus pesticides

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Abstract

A plethora of publications has continuously reported electrochemical biosensors for detection of pesticide. However, those devices rarely accomplish commercial application due to technical issues associated with the lack of stability and high cost of the biological recognition element (enzyme). Alternatively, the biomimetic catalysts have arisen as a candidate for application in electrochemical biosensors to overcome the enzymatic drawbacks, combining low cost scalable materials with superior stability. Herein, for the first time, we propose a biomimetic biosensor for organophosphorus pesticide detection employing a functionalized polyacrylamide, polyhydroxamicalkanoate (PHA), which mimics the performance of the acetylcholinesterase (AChE) enzyme. The PHA bears functional groups inserted along its backbone chain working as active sites. Thereby, PHA was immobilized on screen printed electrodes (SPE) through a blend formation with poly(ethylene glycol) methyl ether (mPEG) to prevent its leaching out from the surface. Under optimum conditions, the biomimetic sensor was employed for the amperometric detection of paraoxon-ethyl, fenitrothion and chlorpyrifos ranging from 1.0 and 10.0 μmol L^{-1} with a limit of detection of 0.36 μmol L^{-1}, 0.61 μmol L^{-1}, and 0.83 μmol L^{-1}, respectively. Typical AChE-based interfering species did not affect the PHA performance, which endorsed its superior behavior. The proposed biomimetic biosensor, denoted as SPE/PHA/mPEG, represents a significant advance in the field, offering a new path for low cost devices by means of an artificial enzyme, simple configuration and superior stability. Moreover, the biosensor performance can be further improved by modifying the electrode surface to enhance electronic transfer rate.

Keywords: biomimetic biosensor, acetylcholinesterase, organophosphorus pesticide, screen printed electrode, polyacrylamide.