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A stable acetylcholinesterase biosensor based on Au nanorod@SiO_2 core-shell nanoparticle doped chitosan-TiO_2 hydrogel for detecting organophosphate pesticides

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In our previous work, we have developed a highly stable electrochemical acetylcholinesterase (AChE) biosensor for detecting Organophosphorus Pesticides (OPs) with a detection limit of 29 nM, simply by adsorption of AChE on Chitosan (CS) film modified CS-TiO_2 hydrogel immobilization matrix (denoted as CS/TiO_2-CS), which was transformed from colloidal solution to hydrogel *in situ* immediately after being cast on graphene film modified glassy carbon electrode. In this work, Au nano-rod (AuNR)@SiO_2 core-shell nanoparticles were synthesized and doped into the CS-TiO_2 hydrogel by directly mixing the nanoparticles with the colloidal solution before the hydrogel formation. The doping of AuNR@SiO_2 was found being homogeneous and significantly improving the electro-conductivity of the immobilization matrix. In contrast, the aggregation of naked AuNRs in the colloidal solution was observed. The mesoporous SiO_2 shell could not only protect the Au nanorods from aggregation and also allow the permeation of the enzyme substrate and product through the Au nanorod@SiO_2 nanoparticles. The catalytic activity of the AChE immobilized CS/AuNR@SiO_2@TiO_2-CS to acetylthiocholine is significantly higher than that missing the AuNR@SiO_2 in the matrix. The detection linear range of the biosensor to fenthion, a model OP compound, is from 18 nM to 22.6 μM, with detection limit of 10 nM and a total detection time of about 25 min. The biosensor is very reproducibly and stable both in detection and in storage and can accurately detect the fenthion levels in cabbage juice samples, providing a promisingly practical OPs biosensor with high reliability, simplicity, sensitivity and rapidness.

Biography

Hui-Fang Cui has been a Professor in School of Life Sciences, Zhengzhou University, China since 2007. She was recently appointed as Distinguished Professor by Zhengzhou University. She has received her PhD degree from Department of Biological Sciences, National University of Singapore in 2006 and worked as a Postdoctoral Research Fellow at Department of Biological Sciences, National University of Singapore from 2007 to 2008 and at School of Chemical and Biomedical Engineering, Nanyang Technological University, Singapore from 2006 to 2007. She has published more than 30 papers in reputed journals. Her research interests are biosensors, biotechnology and nanotechnology.

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