A Sensitive Acetylcholinesterase Biosensor Based on Screen Printed Electrode Modified with Fe₃O₄ Nanoparticle and Graphene for Chlorpyrifos Determination

Hui Wang¹, Guo Zhao¹, Dongfei Chen², Zhiqiang Wang³, Gang Liu^{1,*}

¹ Key Lab of Modern Precision Agriculture System Integration Research and Key Lab of Agricultural Information Acquisition Technology Ministry of Education, China Agricultural University, Beijing 100083 P.R. China;

² College of Agricultural Engineering and Food Science, Shandong University of Technology, Zibo 255049, P.R. China;

³ College of Computer Science and Technology, Shandong University of Technology, Zibo 255049 P.R. China)

*Email: pac@cau.edu.cn

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Biosensor based on enzyme inhibition for the determination of organophosphate pesticides residue was developed and fabricated, which explored to modify screen-printed electrode (SPE) with acetylcholinesterase (AChE) and a composite membrane of magnetic nanoparticle (Fe₃O₄) and graphene (GR). Due to the large specific surface area and high electron transfer of graphene and the strong absorbability and affinity of Fe₃O₄ for the phosphoric group, the nanocomposite film provided much active site and suitable microenvironment to improve the combination with AChE and maintain the enzymatic activity. The AChE/Fe₃O₄/GR/SPE was characterized by different methods including cyclic voltammetry and differential pulse voltammetry, indicating the biosensor had some excellent properties, such as high sensitivity, reproducibility and repeatability. Under optimum conditions, the inhibition rates of AChE were proportional to the concentrations of chlorpyrifos in the range from 0.05 µg/L to 100 µg/L with the coefficients of 0.981 and the detection limits were found to be 0.02 µg/L (S/N=3). This proposed biosensor exhibited high accuracy, reproducibility and regeneration, which was suitable for trace detection of chlorpyrifos residue in vegetable.

Keywords: Organophosphorus pesticide, Graphene, Fe₃O₄ nanoparticle, Acetylcholinesterase, Biosensor, SPE

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