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Fabrication of $Au_{core}Co_3O_{4shell}$/PAA/HRP Composite Film for Direct Electrochemistry and Hydrogen Peroxide Sensor Applications

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A completely new biosensor composed of cube-shaped $Au_{core}Co_3O_{4shell}$ nanoparticles ($Au_{core}Co_3O_{4shell}$), polyacrylic acid (PAA), and horseradish peroxidase (HRP) modified film electrode was fabricated for the first time. The biocompatibility and electrochemical properties of the resulting $Au_{core}Co_3O_{4shell}$-PAA-HRP composite film were studied by electrochemical impedance spectroscopy, UV-visible spectroscopy, and cyclic voltammetry. The UV-vis spectrum obtained suggests that HRP retains its native conformation in the modified film. The immobilized HRP shows a pair of quasi-reversible redox peaks at −0.31 V in 20 mM PBS (pH 7.0), and the biosensor shows a fast amperometric response to hydrogen peroxide with a linear range of 2.0×10^{-6} to 3.7×10^{-4} M. The kinetic parameters such as k_s (electron transfer rate constant) and K_M (Michaelis-Menten constant) are evaluated to be about 7.4 s^{-1} and 0.91 mM, respectively. These indicate that the cube-shaped $Au_{core}Co_3O_{4shell}$ nanoparticles are an ideal candidate material for direct electrochemistry of redox proteins and for the construction of related enzyme biosensors, and that they may find potential applications to biomedical, food, and environmental analyses and detection.

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