Functionalized Polyethyleneimine-gold Nanoparticles-Porphyrin Nanocomposite for Electrochemical Glucose Biosensing

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In this work, a novel polyethyleneimine-gold nanoparticles-porphyrin (PEI-AuNPs-Fe^{III}MPIX) nanocomposite was constructed by a simple method to achieve excellent electrochemical properties. Firstly, AuNPs were reduced and stabilized by PEI, and then Fe^{III}MPIX was conjugated to this scaffold through amidation reaction. After that, the nanocomposite was functionalized by 4-mercaptophenylboronic acid (MPBA) through Au-S bond for the determination of glucose. By virtue of high affinity of MPBA for 1, 2-diols of glucose, electrochemical activity of Fe^{III}MPIX and the synergistic effect of PEI-coated AuNPs, this biosensor displayed good sensitivity and selectivity for glucose. The electrochemical response was linearly related to glucose concentration in the range from 10 to 350 μM ($R^2=0.9911$). A low detection limit of 2.16 μM (S/N=3) and a high sensitivity of 13.88 $\mu\text{A mM}^{-1} \text{cm}^{-2}$ was obtained. In addition, this biosensor exhibited excellent anti-interference ability against common interferents such as ascorbic acid (AA), dopamine (DA), alanine (Ala) and proline (Pro), and held satisfactory analytical performance for the determination of glucose in human serum samples, indicating promising practical applications in bioanalysis and clinical diagnosis.

Keywords: Porphyrin; Gold nanoparticle; Polyethyleneimine; 4-Mercaptophenylboronic acid; Glucose sensor

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