Non-Enzymatic Glucose Sensors for Sensitive Amperometric Detection Based on Simple Method of Nickel Nanoparticles Decorated on Magnetite Carbon Nanotubes Modified Glassy Carbon Electrode

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A sensitive and selective non-enzymatic glucose sensor was developed based on magnetite (Fe_3O_4) and nickel nanoparticles decorated carbon nanotubes (Fe_3O_4 -CNTs-NiNPs). Fe_3O_4 nanoparticles were in situ loaded on the surface of carboxylated multi-walled carbon nanotubes (CNTs-COOH) by a chemical co-precipitation procedure. Nickel nanoparticles (NiNPs) were prepared through reducing nickel chloride by hydrazine hydrate and then decorated on Fe_3O_4 -CNTs using ultra-sonication. The as-prepared Fe_3O_4 -CNTs-NiNPs was characterized using transmission electron microscopy (TEM) and X-Ray Diffraction (XRD). Glucose sensor was fabricated using glassy carbon (GC) coated with Fe_3O_4 -CNTs-NiNPs composites film. Electrochemical investigations indicate that the Fe_3O_4 -CNTs-NiNPs/GC electrode possesses excellent performance in the electrochemical oxidation of glucose at an applied potential of +0.55 V (vs. Ag/AgCl) in 0.1 M NaOH solution. The linear dynamic range for glucose amperometric detection ($E_{\text{app}} = +0.55$ V) was observed from 10 μM to 1.8 mM ($r^2 = 0.998$) with the sensitivity of 335.25 $\mu\text{A mM}^{-1}$; and a low detection limit of 6.7 μM ($S/N = 3$). In addition, the fabricated sensor was successfully applied to determine glucose in honey and energy drinks with good results.

Keywords: Amperometric sensor; carbon nanotubes; magnetite, nickel nanoparticles; glucose

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