Electrochemical sensing of glucose by reduced graphene oxide-zinc ferrospinelns

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We have developed ZnFe2O4 magnetic nanoparticles/reduced graphene oxide nanosheets modified glassy carbon (ZnFe2O4/rGO/GCE) electrode as a novel system for the electrochemical glucose sensing. Via a facile in situ hydrothermal route, the reduction of GO and the formation of ZnFe2O4 nanoparticles occurred simultaneously. This enables the ZnFe2O4 nanoparticles dispersed on the reduced graphene sheet. Characterization of nanocomposite by X-ray diffraction (XRD) and transmission electron microscopy (TEM) clearly demonstrate the successful attachment of ZnFe2O4 nanoparticles to graphene sheets. Electrochemical studies revealed that the ZnFe2O4/rGO/GCE possess excellent electrocatalytic activities toward the oxidation of glucose and the performance of sensor is enhanced by integration of graphene nanosheets with ZnFe2O4 nanoparticles.

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1. Introduction

Reduced graphene oxide (rGO) is an excellent electron-transporting material in the photocatalytic process. It is a single layer of two-dimensional sp2 hybridized carbon nanosheet with great thermal conductivity, large surface area, excellent electron mobility, high transparency and mechanical strength flexibility [1]. Recently integration of graphene nanosheets with metal nanoparticles to form graphene-metal hybrids has been intensively developed in various applications such as catalysis, surface enhanced raman scattering, targeted drug delivery and removal of organic pollutants [2–4]. Graphene acts as a separator to prevent the particles aggregating and the synergetic effects between graphene and the second components improves hybrids functionalities [5,6]. Spinel ferrites (MFe2O4) are important class of magnetic materials where oxygen forms a face cubic centered (fcc) close packing, and M2+ and Fe3+ occupy either tetrahedral or octahedral interstitial sites [7]. Among the magnetic nanoparticles, nanosized zinc ferrite (ZnFe2O4) particles are occupying an important place for their unusual properties such as narrow bandgaps, excellent visible-light response, good photochemical stability and favorable magnetism [8,9]. Although the enzymatic glucose sensors have obtained the majority of glucose sensors in the market due to being fast and reversible but they still suffer from the lack of stability attribute to the intrinsic nature of enzymes and it remains the main problem in this type of sensors [10,11]. It is necessary to utilize sensors which are stable at high temperatures and under aggressive environment. In this article, we reported a new type of flexible electrochemical sensor based on ZnFe2O4/rGO hybrids as an enzymeless glucose sensor. We have fabricated ZnFe2O4/rGO nanoparticles on glassy carbon electrode (GCE) substrate using different graphene content. The electrochemical oxidation behaviour of glucose was investigated and the modified electrode exhibited a wide linear range and a low detection limit towards glucose as well as possess excellent stability and reproducibility. The successful dispersion of magnetic ZnFe2O4 nanoparticles on graphene nanosheets has enabled the construction of a high sensitive sensor due to the low electronic noise from thermal effect.

2. Materials and methods

2.1. Chemicals and reagents

Zn(NO3)2·6H2O, Fe(NO3)3·9H2O, ethanol (C2H5OH, 99.7% purity), α-(+)-glucose, uric acid (UA), ascorbic acid (AA), sucrose and fructose were obtained from Aldrich. All other reagents were of analytical grade and were used as received. Deionized water

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