SYNTHESIS, CHARACTERIZATION AND ELECTROCHEMICAL APPLICATIONS OF Fe₃O₄ AND Fe₃O₄/Au NANOCOMPOSITES

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Nanoparticles (NPs), such as metal/metal-oxide nanoparticles have widely been used to construct modified electrodes and biosensors since they exhibit unique physical and chemical properties depending on to their size and high defects density found on their corner or edge surface sites [1]. Magnetic nanomaterials (MNs) have also been attracted interest nowadays because of their strong magnetic properties, high separation efficiency, high specific surface area, good biocompatibility and low toxicity [2,3]. Besides, magnetic NPs can be controllably separated from bulk systems by means of an external magnetic field. Concerning electrochemical applications, this property enables us to immobilize enzymes on substrate surfaces and thus construct magnetically controllable bioelectrochemical systems [4]. On the other hand, gold nanoparticles (Au-NPs) possess important electronic, optical, thermal, and catalytic properties. Au-np has received so much attention in the field of electroanalysis due to its physico-chemical properties and good biocompatibility. Additionally, modification of electrode surfaces with this particle provides a suitable microenvironment similar to that of redox protein. It has been believed that Au-NP catalyzes the enzymatic reaction by allowing direct electron transfer between the electrode and enzyme active center by means of the conducting tunnels of gold nanocrystals [5]. The use of nanocomposites which comprising two or more metallic elements has drawn much attention due to the potential for combining the advantages of each metal and enhancing physical and chemical properties [2]. Core-shell/bimetallic nanoparticles, because of their unique physical and chemical properties are used in many fields such as semiconductor electronics and biomedical industries [6]. The bimetallic nanostructure, such as gold-coated magnetic core-shell nanoparticles, is an ideal composite system [2]. AuNPs shell not only protect the core from oxidation and corrosion, but also provides a platform for surface modification and functionalization[7]. On the other hand, magnetic NP shells are used in immobilization of proteins as building block by providing direct electron transfer between the electrode and immobilized redox protein [5].

In this study, Fe₃O₄ and Fe₃O₄/Au nanocomposite materials were prepared by our group. Prepared nanomaterials were then characterized by using transmission electron microscopy, UV–visible absorption spectrosopy and electron dispersive spectroscopy (EDS) techniques. Then these materials were used as modifiers both for glassy carbon electrode and composite paste electrode. The response of these nanostructure modified electrodes were compared by following voltammetric signals that were obtained for H₂O₂ and K₃Fe(CN)₆ analytes.

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References