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SILVER NANOPARTICLE-MODIFIED GRAPHITE PENCIL ELECTRODE FOR SENSITIVE ELECTROCHEMICAL DETECTION OF CHLORIDE IONS IN PHARMACEUTICAL FORMULATIONS

Yousif Taha Maaroof[1,2*] and Kamal Mustafa Mahmoud[1]

[1]Department of Chemistry, College of Science, Salahaddin University-Erbil, Iraq
[2]Department of Petroleum Technology, Erbil Technology College, Erbil Polytechnic University, Iraq

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ABSTRACT. For the first time, silver nanoparticles (AgNPs) were fabricated with graphite pencil electrode (GPE) by immersing a bare hard black pencil (HB pencil) in $AgNO_3$ solution mixed with extract *Quercus infectoria* solution, followed by placing directly against to UV lamp (254 nm) and kept for 30 min. Silver modified-GPEs were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy dispersive X-ray spectrometer (EDX). The silver nanoparticles fabricated with graphite pencil electrode (AgNPs–GPE) showed excellent selectivity to chloride ion, as well as excellent reproducibility, together with it has several advantages such as sensitivity, simplicity, low cost, green, and fast response. The maximum oxidation cyclic voltammogram current of the AgNPs-PGE was found at 160 mV. The linear range of chloride ions detection is between (0.8-52 mmol L^{-1}), and the limit of detection (LOD) of chloride ions is 0.041 mmol L^{-1}. Finally, the Silver fabrication electrode was used to determine the chloride ion concentration in drugs, such as phenylephrine, metformin, procaine, and dopamine formulated with hydrochloride, and satisfactory results were obtained.

KEY WORDS: Electrochemical sensor, Cyclic voltammetry, Pencil graphite electrode, Chloride ion

INTRODUCTION

Chloride ions at their different concentrations are wide distribution in world, such as medicine and health [1], building [2], clinical diagnosis [3], environmental monitoring [4, 5], industrial applications [6], and agricultural production [7]. Therefore, several traditional methods for detecting concentration of chloride ion in real samples were mentioned in the literature, namely titration [8], ion chromatography [9], colorimetry [10], fluorescence spectroscopy [11], and square wave voltammetry [12, 13]. Although these methods have many advantages, they also have many disadvantages such as pretreatment sample process is complex, using expensive equipment, more sample consumption, time consuming, and many other shortcoming [14]. The sensors have wide applications in various diverse areas such as, gas sensor for detecting NH_3 and HNO_3 [15], biosensor for detecting glucose [16], it is produces to different sets of requirements. Ion selective electrodes are most popular and commercially available methods for sensing different ions, including chloride [17-19]. Voltammetric methods using different working electrodes are often preferred for sets of applications in electrochemical methods, due to some advantages such as high sensitivity, fastness, simplicity, portability, as well as the possibility to analysis various turbid or coloured solutions [20, 21]. Recently, nanocomposite materials use with electrochemical sensing technology are mostly used to detect a broad range of organic, inorganic, and heavy-metal ions, which have excellent performance and increase sensitivity of electrochemical detection, because nanomaterials are prepared from the specific type of compounds, when prepared nano-compounds have large surface area, by increasing surface area per mass of a material, a greater amount of the material of sensor can come into contact with surrounding sample materials compare to bulk compounds. In addition, there are other advantages for nanocomposite materials

*Corresponding author. E-mail: yousif.maaroof@epu.edu.iq