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ELECTROCHEMICAL DETECTION OF CAPECITABINE USING AN AG/ GRAPHENE / GLASSY CARBON ELECTRODE

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Introduction

Capecitabine (CCB), known as an anti-cancer drug is a novel, orally administered fluoropyrimidine carbamate used to treat breast esophageal, gastrointestinal and genitourinary tract cancers. Due to the fact that the number of cancer patients has increased considerably, the CCB consumption increased continuously, so, its measurement is essential and required. To improve the sensitivity of electrodes used in the detection CCB new materials such as graphene and silver particles that can increase electron transfer efficiency have been reported. Due to their properties, such as electrical conductivity, high surface area, comparatively low-cost and high chemical stability, modification of carbon electrode (glassy carbon-GC) and graphene oxide (GO) with silver particles (Ag) is widely explored in electroanalysis. This work presents the development of a commercial GC electrode modified with reduced (GO) and with Ag for the CCB oxidation envisaging its detection.

Materials and methods

Electrochemical measurements were performed using a potentiostat - galvanostat Autolab PGSTAT 302, controlled by a computer using GPES 4.9 software and a cell with three electrodes. The cell structure includes a GC working electrode, electrochemically modified with GO and Ag (Ag/GO/GC) a platinum counter-electrode (Pt) and a saturated calomel electrode (SCE) used as the reference electrode. The support electrolyte was a solution of 0.1 M NaOH and CCB used was an analytical-grade reagent from Merck. 4 mg/ml graphene oxide (GO), aqueous suspension was used for GO electrodeposition and 4 mM $AgNO_3$ for silver deposition. The electrochemical methods applied in the research study were chronoamperometry (CA) and cyclic voltammetry (CV).

Results and conclusions

The first stage of obtaining the new electrode was the deposition of GO onto the surface of the commercial GC electrode at the electrodeposition potential of -1.5 V, for 120 s. The second stage consists of the modification of the electrode obtained in the first stage (GO/GC) with Ag metal particles to the electrodeposition potential of -1.3 V, for 5s. The electrochemical performance of novel obtained electrode (Ag/GO/GC) was investigated by CV. The obtained peak currents were linearly dependent on the CCB concentration within the concentration range of 10 - 60 µM. A good sensitivity (0.160 $\mu A \cdot \mu M^{-1}$) and a better limit of CCB detection (0.817 µM) was achieved at the anodic potential of +0.300 V/SCE.

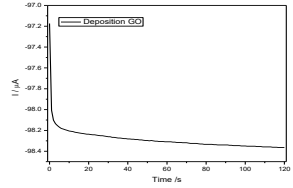

Fig.1a. Chronoamperogram recorded during the deposition of graphene oxide (GO) on the glassy carbon electrode (GC).

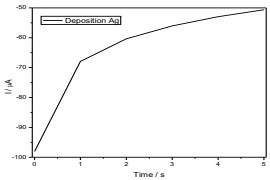

Fig.1b. Chronoamperogram recorded during the deposition of silver (Ag) on the GR modified glassy carbon electrode (GC).

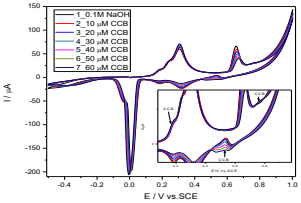

Fig.2a. Cyclic voltammograms recorded at the Ag/GO/GC electrode in 0.1 M NaOH and in the presence of 10-60 µM CCB.

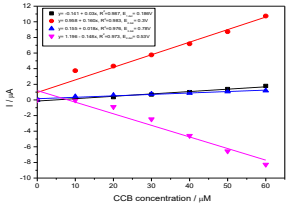

Fig.2b. Calibration plots of the currents recorded at E_1 = +0.186V/SCE, E_2 = +0.300V/SCE, E_3 = +0.780V/SCE and E_4 = +0.530V/SCE vs. CCB concentrations.

Based on the results of this study including the stability, selectivity, repeatability, sensitivity and reproducibility of the used method (CV), it can be concluded that GC electrode modified with GO reduced electrochemically and decorated with silver is appropriate for the electrochemical detection of CCB in aqueous solutions.

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