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A simple procedure to prepare graphene CVD modified glassy carbon electrode

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Introduction

Graphene, a monolayer of sp^2 bonded carbon atoms arranged in a hexagonally lattice[1], was first isolated in 2004. Thanks to its outstanding mechanical, optical and electrical properties, graphene has attracted widespread interest in diverse areas, and in particular in the field of electrochemistry, involving energy storage/generation and the fabrication of electrochemical sensors. In this work, we describe a new procedure to manufacture modified glassy carbon (GC) electrode by using graphene produced by cold vapor deposition (CVD) process aiming its use in electroanalytical applications.

Results and Discussion

The process to modify CG electrode with graphene CVD is simple, fast and does not require special tools. Initially, graphene CVD monolayer sheet was transferred to poly-butylene-adipate-co-tereftalate (PBAT) using the Direct Dry Transfer method[2]. The polymer transferred graphene was placed on top of GC electrode (d = 2.0 mm) and warmed until 120°C. The PBAT was removed from the surface of the GC electrode by using a chloroform bath. After the complete removal of the polymer residue, the electrode exposed surface was characterized with Raman Spectroscopy and Optical Microscopy. Figure 1 shows the Raman spectra of GC electrode before and after the transfer.

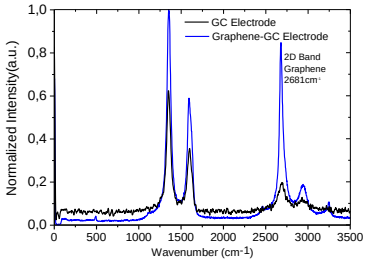

Figure 1. Raman spectra of GC electrode before (black) and after (blue) the transference.

It is possible to observe an increase of 2D band located at 2681 cm^{-1}. This assignment is typical of graphene monolayer[3]. Figure 2 shows the graphene-GC electrode optical image and the Raman image of the same area. The Raman image was composed by 2D band intensity and show a complete coverage of the sample.

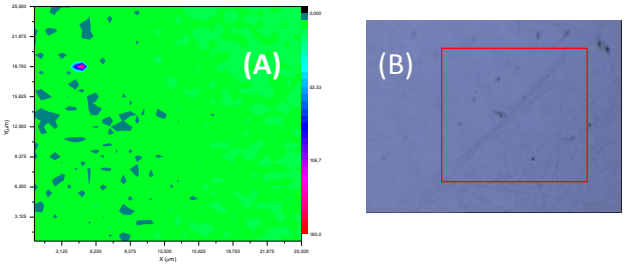

Figure 2. Graphene-GC electrode optical image (A) with 100x magnification and the Raman image - 25x25 µm (B), 532 nm LASER.

The performance of the GC electrode before (A) and after (B) its modification with graphene CVD for voltammetric detection of H_2O_2 in 0.10 mol L^{-1} phosphate buffer, pH 7.0 is depicted in Figure 3.

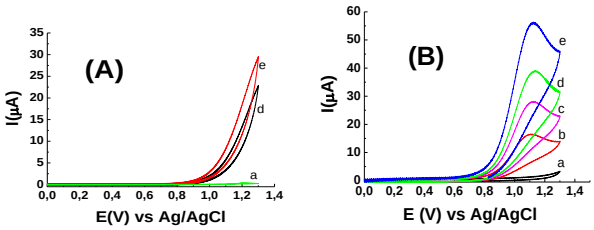

Figure 3. Cyclic voltammograms of 0.10 mol L^{-1} phosphate buffer solution (a) + H_2O_2 (b-e) obtained at GC electrode (A) and at graphene CVD GC electrode. H_2O_2 concentrations: b) 2.0 mmol L^{-1}; c) 4.0 mmol L^{-1} d) 6.0 mmol L^{-1} and e) 8.0 mmol L^{-1}. Scan rate = 50 mV s^{-1}.

The voltammetric response of the graphene CVD modified GC electrode exhibits appreciable electrocatalytic effect and higher sensitivity for H_2O_2 detection in comparison to the unmodified GC electrode.

Conclusions

The proposed procedure is simple and fast for modification of GC electrode with graphene CVD. The modified electrodes offer new possibilities to explore the attractive characteristics of the graphene for application in electrochemical sensors.

Acknowledgment

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