A NEW APPROACH OF GRAPHENE OXIDE SYNTHESIS AND ITS APPLICATION POSSIBILITIES

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Graphene oxide (GO) displays good hydrophilicity, unlike graphene and graphite powder due to the presence of oxygen-containing functionalities such as epoxy, hydroxyl, carboxyl, and carbonyl [1]. Besides, the amount of oxygen-containing functional groups introduced during the chemical oxidation of graphite surface plays a crucial role in controlling the structure, electronic, optical properties, and the application potential of GO and its derivative reduced graphene oxide (rGO) [2, 3]. The attachment of a greater amount of oxygen-containing functional groups onto the GO surface expands the distance between graphitic layers, consequently facilitating the effective exfoliation process. Thus, the main goal is to produce GO with the best characteristics and controllable oxygen functionalities at a large scale.

Our study aimed to develop a newly modified Hummers' synthesis method and provide a scalable process to yield GO, as well as the characterization and testing the electrochemical performance of new prepared samples in hydrogen peroxide detection. In this work, we present two newly modified Hummers' methods which include the pre-oxidation of natural graphite powder by mixtures of H_3BO_3/H_2SO_4 and $H_3BO_3/H_2SO_4/CrO_3$. To achieve a complete comprehension on the effect on GO structure, nature of oxygen functionalities introduced during the oxidation protocols and composition, a combination of various analysis methods such as Raman spectroscopy, X-ray diffraction analysis, X-ray photoelectron spectroscopy, Boehm titration, were used. Electrochemical measurements, in particular, cyclic voltammetry and differential pulse voltammetry were used to evaluate the sensitivity of the obtained samples sensitivity toward hydrogen peroxide detection.

The analysis revealed that GO obtained by modified Hummers' method using a pre-oxidation step with $H_2SO_4/H_3BO_3/CrO_3$ mixture has a higher oxidation degree (C/O = 1.03) than that GO prepared by traditional Hummers' method C/O = 1.34 and using a pre-oxidation step with H_2SO_4/H_3BO_3 mixture (C/O = 1.35). Moreover, rGO derived from new synthesized GO using $H_2SO_4/H_3BO_3/CrO_3$ mixture provides a unique opportunity for future work in this area due to its relatively high sensitivity 70.33 $\mu A \cdot mM^{-1}\ cm^{-2}$ toward H_2O_2 detection.

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