Abstract
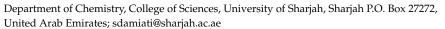
Electrochemical Biosensor Based on Graphene–Folic Acid Nanobiocomposite for Detecting Overexpressed Folate Receptor in Breast Cancer Cells [†]

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Abstract: Enhancing the analytical performance of biosensors is a key factor in fabricating well-organized sensing platforms with high sensitivity. The main challenge in developing selective and sensitive biosensors is the lack of a sensing architecture that allows the detection of small biomolecules at low concentrations in crowded biological media. The functionality and stability of biosensors improve when the surface patterns are in a well-organized arrangement, and when biomaterials are present at a good density. It is common to use antibodies or aptamers as capture molecules for the target analyte, but they have limitations in terms of density and orientation when immobilized on sensor surfaces. Alternatively, simple non-toxic molecules such as folic acid (FA) can be used as recognition elements. They have the ability to construct nanostructures and produce sensing devices with good selectivity and sensitivity. In this study, the conjugation of FA to reduced graphene oxide (rGO) was prepared and then used to functionalize a glassy carbon electrochemical (GCE) electrode for the detection of breast cancer cells (MCF-7). The cyclic voltammetry (CV) technique was employed to characterize the electrochemical proficiency of the developed electrode for detecting MCF-7 cells. The rGO-FA nanobiocomposite demonstrated itself as a promising substrate, offering good electrochemical signals after capturing cancer cells in the range between 1×10^3 and 1×10^5 cells/mL. The CV results indicated the successful binding of the folate receptor overexpressed on the surface of the cell membrane in the MCF-7 cells to the rGO-FA-modified sensor. The simple design of rGO-FA/GCE showed good, reliable, and satisfactory performance, which may significantly contribute to the development of low-cost biosensors for future cancer diagnosis.

Keywords: electrochemical biosensor; folate receptor; graphene; cancer cells

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