Interfacial Capacitance of Graphene Based Devices: A Sensing Platform For Biomarkers

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Abstract

Sensors based graphene has received widespread attention due to its unique properties such as high electrical conductivity and high surface area that makes these devices exhibit high sensitivity to analytes bindings on its surface. Most of these sensors are based on changes in the resistivity, conductivity and/or optical properties of graphene that are proportional to the analyte concentration [1]. However, only few reports have focused on understand the interfacial capacitance (Ci) developed in the graphene electrolyte interface and how to apply this as biosensing mechanism in graphene devices. Herein, we address the tuning of graphene interfacial capacitance in the label-free detection of HER-2, one of the most common proteins that act as biomarkers for breast cancer. The interfacial capacitance of graphene was determined by electrochemical impedance spectroscopy measurements, based on procedure showed by Ji *et al* [2]. As working electrode, a monolayer graphene growth by chemical vapor deposition process (CVD) was transferred on 300 nm SiO_2/Si substrate and electrically connect by a copper tape. The HER-2 antibody was immobilized on graphene surface, followed by a blocking step. The impedance spectra were recorded in each step of modification of the graphene layer. Figure 1 shows the C-V curves for the graphene after immobilizing protein A, HER-2 antibody and in the presence of different concentrations of HER-2 antigen. The C-V curve for the graphene clearly shown the V shape and it is possible to see that the minimum value of Ci shifted to high potentials at a function of the immobilization of protein A and antibodies on graphene surface and interaction with ultra-low concentration of HER-2 biomarkers (pg mL^{-1}). Our results show that graphene interfacial capacitance is a powerful tool to detect low concentration of biomarkers, improving the development of high sensitive graphene capacitor biosensors.

Acknowledgments

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References

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[2] Ji, H. X.; Zhao X.; Ruoff, R. S. Nat Commun 5 (2014) 3317.

Figures

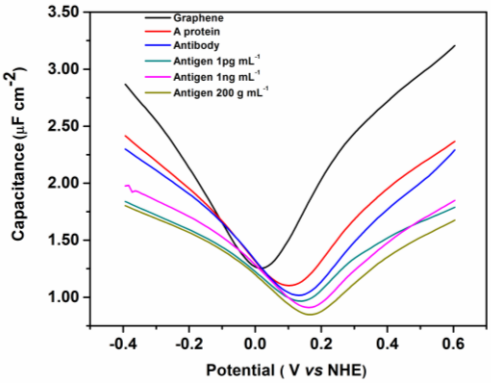

Figure 1: C-V curve for the graphene, after immobilizing of protein A, HER-2 antibody and in the presence of different concentrations of HER-2 antigen at 100 Hz of frequency, in PBS solution pH 7.4.