Electrochemically active graphene oxide for thrombin biosensor

Dongchul Choi and Kyuwon Kim

Department of Chemistry, Incheon National University, Incheon, Republic of Korea

Graphene, a one-atom-thick two-dimensional carbon material, has recently attracted great interests because of its unique structure and properties. Graphene oxide (GO), an insulating and disordered analog of highly conducting crystalline graphene, has been used in various electrochemical applications. GO is an amphiphile with hydrophilic ionizable edge and hydrophobic basal plane which also serve as good places for attachment of biomolecules, such as nucleic acids and peptides.

Here, we report an electrochemically reducible property of GO that enables quantitative analysis. GO serves as an indicator generating electrochemical signal for detecting target materials by measuring the current during the electrochemical reduction of GO, which provide a quantitative measure of the target concentration in solution.

We demonstrate a thrombin biosensor based on the electrostatic interaction of edge site of GO and thrombin pre-attached on gold electrode surfaces. We immobilized thrombin-binding aptamer on the surfaces which undergoes a transition to a G-quadruplex structure upon binding the thrombin. We demonstrate that the electrochemical reduction current of the adsorbed GO is linearly related to the quantity of thrombin on the electrode surfaces, and that the sensors permits a highly specific detection of them without interferences of other proteins, respectively,