Novel approach to fabrication of DNA Biosensor Based on a Carboxylated Graphene Oxide Decorated with Fe₃O₄ NPs for the Detection of Typhoidal Salmonella

Shichao Xu^{1,2,3,*}, Hao Duo¹, Chunming Zheng^{1,2}, Shihuai Zhao^{1,2}, Shidong Song^{1,2}, Gabriel Simon⁴

¹ School of Environmental and Chemical Engineering, Tianjin Polytechnic University, 399 Binshui West Road, Tianjin 300387, China

² State Key Laboratory of Hollow Fiber Membrane Materials and Membrane Process, Tianjin Polytechnic University, 399 Binshui West Road, Tianjin 300387, China

³ Tianjin Engineering Center for Safety Evaluation of Water Quality & Safeguards Technology Tianjin Polytechnic University, 399 Binshui West Road, Tianjin, 300387, China

⁴ 18, rue du 8 mai 194549180, St Barthelemy d'Anjou Cedex, Esaip, France

*E-mail: xushichao@tjpu.edu.cn

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Diseases caused by typhoidal salmonella have led to a wide range of panic. It is thereby critically urgent to develop high-efficiency, ultrasensitive techniques for typhoidal salmonella detection. Carboxylated graphene oxide (CGO), features as one of the most crucial substrates to immobilize probe DNA for the fabrication of DNA biosensor, has been studied extensively so far. However, the reagents involved in the protocols proposed previously due to their strong alkalinity and extremely high reducing properties would impose significant impact to their performance and application. Herein, we develop a novel strategy for effective carboxylation graphene oxide with sodium citrate and chloroacetic acid. X-ray photoelectron spectroscopy (XPS) results demonstrate the density of carboxyl is improved more than twice, in consistent with the results of nuclear magnetic resonance (NMR). Furthermore, decorated with cost-effective Fe₃O₄ NPs, the conductivity of CGO could be enhanced remarkably, furthermore, far more 5'-end amino labeled probe DNA would be stably grafted. The performance of stepwise modification of the bioelectrodes is carried out by cyclic voltammetry (CV) and electrochemical impedance spectroscopies (EIS). Differential pulse voltammetry (DPV) studies exhibit a linear response ranging from 10⁻¹⁷ to 10⁻⁹ M for target DNA analysis with the detection limit up to 3.16×10⁻¹⁸ M, using methylene blue (MB) as a redox indicator under optimal conditions. In addition, the as-prepared biosensor provides predominant capability for discriminating the similar target DNA sequences. Eventually, the proposed biosensor is surveyed by real samples and it shows outstanding performance. Consequently, the developed ssDNA/Fe₃O₄ NPs/CGO/GCE can be a promising candidate for real patient samples analysis.

Keywords: Carboxylation; Graphene oxide; Fe₃O₄ nanoparticle; DNA biosensor; Typhoidal salmonella

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