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Facile synthesis of MoS2 nanoflower-Ag NPs grown on lignin-derived graphene for Troponin I aptasensing

Abstract

This article presents the development and application of a green lignin-derived graphene biosensor for Troponin I, a biomarker for Acute Myocardial Infarction (AMI). The graphene was synthesized from oil palm lignin through an optimized laser scribing process. While the three-dimensional nature of the laser-scribed lignin-derived graphene (3D LSG) is advantageous, it suffers from poor electrical conductivity due to the amorphous nature of lignin. Therefore, semi-conductive molybdenum disulphide (MoS2) precursor with conductive green silver nanoparticles (Ag NPs) was added to 0.5, 1.0, 1.5, and 2.0 g of 3D LSG to synthesize 3D LSG_MoS2_Ag NPs hybrids via an aqueous hydrothermal process. Morphological, physical, and structural analyses showed the presence of petal-like MoS2 nanoflower with Ag NPs on the 3D LSG surface. The strong interrelation between 3D LSG, MoS2, and Ag NPs was confirmed by X-ray spectroscopy, Raman spectroscopy and energy dispersive spectroscopy (EDS). Specifically, X-ray spectroscopy revealed the formation of O1s, Ag 3d, C1s, Mo 3d, and S2p in the 3D LSG_MoS2_Ag NPs-2.0 hybrid. Raman spectroscopy revealed an enhancement in the surface area of the 3D LSG_MoS2_Ag NPs-2.0 hybrid, which enhances the detection sensitivity. The 3D LSG_MoS2_Ag NPs hybrid was subsequently chemically modified and immobilised with an aptamer to interact with Troponin I on an impedimetric sensor. The 3D LSG_MoS2_Ag NPs hybrid showed high analytical performance, high specificity, and a ~ 4-fold increment in selectivity, with a detection limit of 100 attomolar. This biosensor has a sensitivity of 31.45 μA mM−1 cm−2, stability of 87%, with a relative standard deviation for reproducibility of 3.8%. © 2023

Keywords

Acute Myocardial Infarction; Biomarker; Biopolymer; Electrochemistry; Laser scribed graphene; Nanosensor