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A quadruplet 3-D laser scribed graphene/MoS2 functionalised N2-doped graphene quantum dots and lignin-based Ag-nanoparticles for biosensing

Abstract

Troponin I is a protein released into the human blood circulation and a commonly used biomarker due to its sensitivity and specificity in diagnosing myocardial injury. When heart injury occurs, elevated troponin Troponin I levels are released into the bloodstream. The biomarker is a strong and reliable indicator of myocardial injury in a person, with immediate treatment required. For electrochemical sensing of Troponin I, a quadruplet 3D laser-scribed graphene/molybdenum disulphide functionalised N2-doped graphene quantum dots hybrid with lignin-based Ag-nanoparticles (3D LSG/MoS2/N-GQDs/L-Ag NPs) was fabricated using a hydrothermal process as an enhanced quadruplet substrate. Hybrid MoS2 nanoflower (H3 NF) and nanosphere (H3 NS) were formed independently by varying MoS2 precursors and were grown on 3D LSG uniformly without severe stacking and restacking issues, and characterized by morphological, physical, and structural analyses with the N-GQDs and Ag NPs evenly distributed on 3D LSG/MoS2 surface by covalent bonding. The selective capture of and specific interaction with Troponin I by the biotinylated aptamer probe on the bio-electrode, resulted in an increment in the charge transfer resistance. The limit of detection, based on impedance spectroscopy, is 100 aM for both H3 NF and H3 NS hybrids, with the H3 NF hybrid biosensor having better analytical performance in terms of linearity, selectivity, repeatability, and stability.

Keywords

Biopolymer; Molybdenum; Nanoparticles; Nanosensor; Nitrogen-graphene