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An Efficient Aptamer-Based Biosensor Developed via Irreversible Pi-Pi Functionalisation of Graphene/Zinc Oxide Nanocomposite

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Abstract : An efficient graphene/zinc oxide (PSE-G/ZnO) platform based on pi-pi stacking, non-covalent interactions for the development of aptamer-based biosensor was presented in this study. As a proof of concept, the DNA recognition capability of the as-developed PSE-G/ZnO enhanced aptamer-based biosensor was evaluated using Coconut Cadang-cadang viroid disease (CCCVd). The G/ZnO nanocomposite was synthesised via a simple, green and efficient approach. The pristine graphene was produced through a single step exfoliation of graphite in sonochemical alcohol-water treatment while the zinc nitrate hexahydrate was mixed with the graphene and subjected to low temperature hydrothermal growth. The developed facile, environmental friendly method provided safer synthesis procedure by eliminating the need of harsh reducing chemicals and high temperature. The as-prepared nanocomposite was characterised by X-ray diffractometry (XRD), scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) to evaluate its crystallinity, morphology and purity. Electrochemical impedance spectroscopy (EIS) was employed for the detection of CCCVd sequence with the use of potassium ferricyanide (K3[Fe(CN)6]). Recognition of the RNA analytes was achieved via the significant increase in resistivity for the double stranded DNA, as compared to single-stranded DNA. The PSE-G/ZnO enhanced aptamer-based biosensor exhibited higher sensitivity than the bare biosensor, attributing to the synergistic effect of high electrical conductivity of graphene and good electroactive property of ZnO.

Keywords : aptamer-based biosensor, graphene/zinc oxide nanocomposite, green synthesis, screen printed carbon electrode
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