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Carbon-nanotube-modified electrodes for amplified enzyme-based electrical detection of DNA hybridization

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Abstract

Carbon-nanotube-modified glassy carbon (CNT/GC) transducers have been developed for enhancing the sensitivity and stability of enzyme-based electrochemical bioassays of DNA hybridization. The amplified signal reflects the interfacial accumulation of phenolic products of the alkaline-phosphatase tracer onto the CNT layer. In particular, chronopotentiometric measurements (following short accumulation periods) offer a substantial enhancement of the response of enzymatically liberated α-naphthol. The CNT modifier also leads to a dramatic improvement in the stability of the amperometric response of α-naphthol. These advantages of CNT/GC electrodes are illustrated from comparison to unmodified glassy carbon electrodes. Factors influencing the adsorptive accumulation of α-naphthol, and the overall performance of the new DNA assay, are assessed and optimized. The attractive performance characteristics of the new multi-amplification electrochemical detection of DNA hybridization are reported in connection to the detection of nucleic acid sequences related to the breast cancer BRCA1 gene.

Keywords: DNA hybridization; Carbon nanotube; Enzyme tag; Naphthol