Electrical detection of DNA using gold and magnetic nanoparticles and bio bar-code DNA between nanogap electrodes

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Abstract: This paper presents an electrical detection method on a DNA biochip that employs a novel approach for ultra sensitive detection of DNA using self-assembled gold nanoparticles and bio-bar-code-based amplification (BCA) DNA. The experimental study relies on three-components oligonucleotide-modified gold nanoparticles, single-component oligonucleotide-modified magnetic nanoparticles and subsequent detection of amplified target DNA in the form of bio-bar-code ssDNA (single strand DNA) using a chip-based detection method. In this study, the BCA technique measures the bar-code DNA rather than the target DNA. There withal, the DNA chips with nanogap electrodes are fabricated by electron-beam lithography. The gap distance and an electrode height are 300 and 65 nm, respectively. Here, the surface between the electrodes and multilayer of gold nanoparticles is established by the hybridization among single strand BCA, the second capture DNA (C2DNA) and the second probe DNA (P2DNA). Measurable current through nanogap electrodes can be obtained over multilayer gold nanoparticles. In this way, magnetic nanoparticles and bio-bar-code DNA are used to amplify obtainable current through nanogap electrodes from the extremely low concentration of target DNA. The detective concentration of target DNA with electrical DNA biosensor is as low as 1 fM for the analysis of current-voltage curves.

Author Keywords: Bio-bar-code DNA detection; DNA Biochip; Electrical Detection; Gold nanoparticles; Magnetic nanoparticles; Self-assembly

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