Ultrasensitive Detection of Nanoparticle-Based Bio Bar-Code DNA Sensor by Using Nano-Gap Electrodes

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Abstract

An ultra sensitive approach to detect the sub femtomolar DNA by using electrical detection method on a DNA biochip has been developed. The system provides high selectivity with sensitivity which is comparable to nano-gap-electrode detection approaches without the need of PCR amplification. Because bio-bar-code DNA approach is a pseudohomogeneous system with both magnetic nanoparticles and gold nanoparticles in solution, low concentration of the probes can be used very efficiently to bind target DNA, thereby reducing time required for high sensitivity detection experiments. Indeed, an advantage of the bio-bar-code DNA approach over conventional microarray sandwich assembly assays is that the entire self-assembly assay can be carried out in sub femtomolar concentration, regardless of target concentration. The system has an excellent dynamic range and is ideally set up for multiplexing.

Keywords: Bio-bar-code DNA detection, Electrical Detection, DNA biochip, Magnetic nanoparticles, Gold nanoparticles, Self-assembly

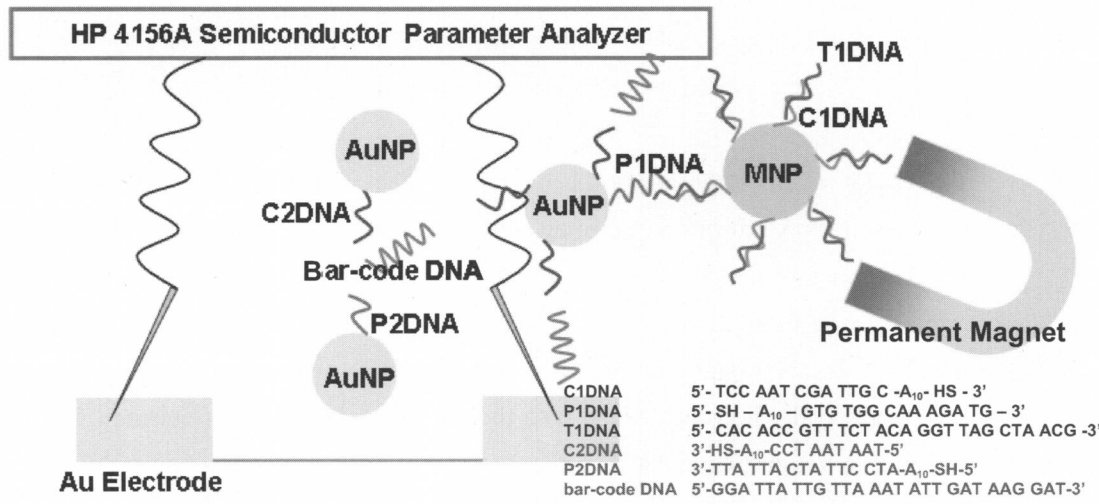
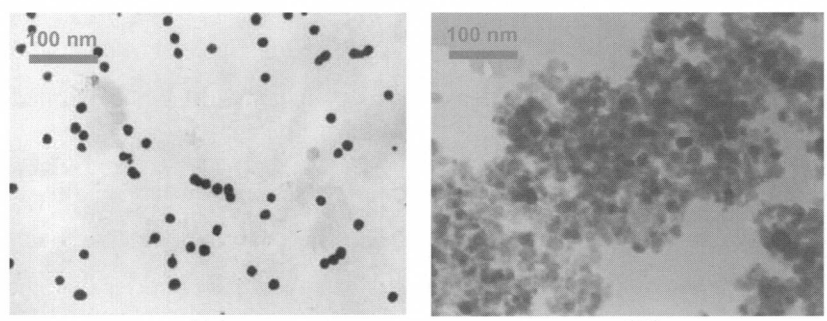


Figure 1. Concept of nanoparticle-based bio-bar-code DNA detection based on sandwich assay and electrical detection.



(A) (B)

Figure 2. TEM images of (A) gold nanoparticles with an average diameter of 12 nm and (B) magnetic nanoparticles with an average diameter of 27 nm.

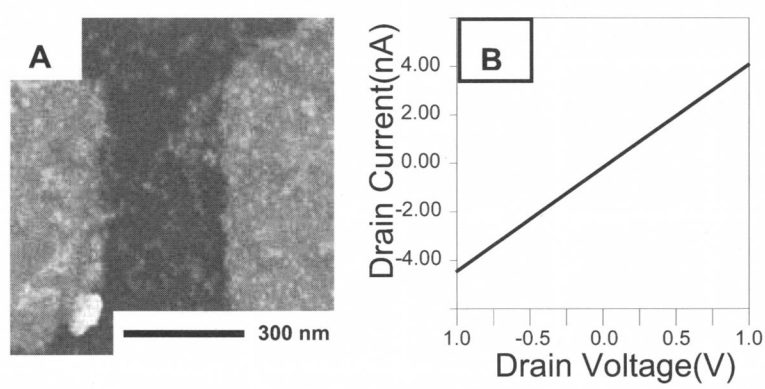


Figure 3. (A) FE-SEM image and (B) *I-V* curve of AuNPs multilayer and nanogap electrode with BCA by using T1DNA which concentration is in the 1fM.