Gold Nanoparticles as Electrochemical Tracers for DNA Hybridization Detection

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ABSTRACT

The use of metal nanoparticles for biosensing has generated great interest with the increasingly understanding of the structure and function of gene, especially for Human Genome Project. By the other side, sequence specific DNA detection has been a topic of significant interest, for its application in diagnosis of pathogenic and genetic diseases [1,2] between other fields.

The high sensitivity of electrochemical transducers, coupled with the low cost and low power requirements led in an extensive research activity in the area of electrochemical DNA biosensors [3,4]. Protocols for detecting DNA hybridization based on a magnetically induced electrochemical stripping detection have been reported [5,6]. Recently, the use of metal nanoparticles (i.e. Au nanoparticles, quantum dots) for DNA genosensors and immunosensing has generated a great interest [7].

Two gold nanoparticles based genosensor designs for detection of DNA hybridization will be presented. Both designs represent models based on magnetically induced direct electrochemical detection of tags linked to the target DNA. They are based on binding target DNA with complementary probe DNA marked paramagnetic beads followed by an effective magnetic separation/mixing process and direct voltammetric detection of Au- quantum dots – DNA – paramagnetic bead conjugate on magnetic graphite-epoxy composite electrode. An advanced magnetic processing technique is used to isolate Au-QD-DNA-paramagnetic bead conjugate and to provide low volume mixing.

The first design is a model system in which a DNA strand is linked with paramagnetic beads and another DNA strand used as a target is coupled with streptavidin gold and finally the electrochemical detection of gold nanoparticles. The second genosensor design is a sandwich assay with more application possibilities. A DNA strand is used as a target and sandwiched between two complementary DNA probes: the first one linked with paramagnetic beads and a second one modified with Au67 nanoparticles via biotin-streptavidine complexation reactions.

Results related to the optimization of the developed genosensors designs will be shown. These will include optimization of the amount of the gold nanoparticles, paramagnetic beads, the time of hybridization along with electrochemical stripping detection variables of the DNA/gold networks magnetically trigged using a magneto DNA probe sensor.

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