

## A novel DNA nanosensor based on CdSe/ZnS quantum dots and synthesized Fe<sub>3</sub>O<sub>4</sub> magnetic nanoparticles

### ABSTRACT

Although nanoparticle-enhanced biosensors have been extensively researched, few studies have systematically characterized the roles of nanoparticles in enhancing biosensor functionality. This paper describes a successful new method in which DNA binds directly to iron oxide nanoparticles for use in an optical biosensor. A wide variety of nanoparticles with different properties have found broad application in biosensors because their small physical size presents unique chemical, physical, and electronic properties that are different from those of bulk materials. Of all nanoparticles, magnetic nanoparticles are proving to be a versatile tool, an excellent case in point being in DNA bioassays, where magnetic nanoparticles are often used for optimization of the hybridization and separation of target DNA. A critical step in the successful construction of a DNA biosensor is the efficient attachment of biomolecules to the surface of magnetic nanoparticles. To date, most methods of synthesizing these nanoparticles have led to the formation of hydrophobic particles that require additional surface modifications. As a result, the surface to volume ratio decreases and nonspecific bindings may occur so that the sensitivity and efficiency of the device deteriorates. A new method of large-scale synthesis of iron oxide (Fe<sub>3</sub>O<sub>4</sub>) nanoparticles which results in the magnetite particles being in aqueous phase, was employed in this study. Small modifications were applied to design an optical DNA nanosensor based on sandwich hybridization. Characterization of the synthesized particles was carried out using a variety of techniques and CdSe/ZnS core-shell quantum dots were used as the reporter markers in a spectrofluorophotometer. We showed conclusively that DNA binds to the surface of ironoxide nanoparticles without further surface modifications and that these magnetic nanoparticles can be efficiently utilized as biomolecule carriers in biosensing devices.

**Keyword:** Optical DNA nanosensor; DNA hybridization; Biosensor; Magnetic nanoparticle; Quantum dot