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RESEARCH ARTICLE

Titanium Dioxide Nanoparticle-Based Interdigitated Electrodes: A Novel Current to Voltage DNA Biosensor Recognizes *E. coli* O157:H7

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Abstract

Nanoparticle-mediated bio-sensing promoted the development of novel sensors in the front of medical diagnosis. In the present study, we have generated and examined the potential of titanium dioxide (TiO_2) crystalline nanoparticles with aluminium interdigitated electrode biosensor to specifically detect single-stranded *E.coli* O157:H7 DNA. The performance of this novel DNA biosensor was measured the electrical current response using a picoammeter. The sensor surface was chemically functionalized with (3-aminopropyl) triethoxysilane (APTES) to provide contact between the organic and inorganic surfaces of a single-stranded DNA probe and TiO_2 nanoparticles while maintaining the sensing system's physical characteristics. The complement of the target DNA of *E. coli* O157:H7 to the carboxylate-probe DNA could be translated into electrical signals and confirmed by the increased conductivity in the current-to-voltage curves. The specificity experiments indicate that the biosensor can discriminate between the complementary sequences from the base-mismatched and the non-complementary sequences. After duplex formation, the complementary target sequence can be quantified over a wide range with a detection limit of 1.0×10^{-13}M. With target DNA from the lysed *E. coli* O157:H7, we could attain similar sensitivity. Stability of DNA immobilized surface was calculated with the relative standard deviation (4.6%), displayed the retaining with 99% of its original response current until 6 months. This high-performance interdigitated DNA biosensor with high sensitivity, stability and non-fouling on a novel sensing platform is suitable for a wide range of biomolecular interactive analyses.

Introduction

Escherichia coli (*E. coli*) O157:H7 was first discovered in1982 [1] and was considered the most virulent foodborne pathogenic bacteria in 1996 [2]. This type of *E. coli*is classified as