A CRITICAL REVIEW ON NANOMATERIALS

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ABSTRACT

Because of the unique electrocatalytic capabilities of nanoscale materials, nanomaterials are being employed for the creation of electrochemical DNA biosensors. They provide tremendous opportunities to interface biological detection events with electronic signal transduction and to develop a new generation of bioelectronic devices with new functionality. Specifically, for applications in biosensors of DNA that are becoming a new interdisciplinary boundary between biological detection and material science, nanomaterials such as noble metal nanoparticles (AU, Pt), carbon nanotubes (CNTs), magnetic nanoparticles, quantum dots and metal oxide nanoparticles have been actively investigated. This article deals with some of the important advancements in this sector in recent years, addressing the problems and obstacles in order to stimulate a greater interest in the development of nanomaterial biosensors and enhancing their applications in the diagnosis and assessment of illness and food safety.

Keywords: Nanomaterials, DNA, Metal.

INTRODUCTION

The possibilities of improving the diagnosis, prevention and therapy of many human illnesses have led the literature to make nuclear acid biosensors more prominent[1-5]. For preventive health care, the diagnosis of genetic abnormalities is obviously very important[1,2]. The prevention and treatment of human diseases is essential for the development of reliable, effective and cost-effective genome sequence determination tools which have wide potential applications including gene expression control, pharmaceutical research and drug discovery, clinical diagnostics, viral/bacterial identification, biological warfare and bioterrorism agents and forensic and genetic discoveries To take use of these possibilities, a range of tests have been developed to detect DNA [3-9]. Molecular diagnostics based on genomic sequence analysis provided a very sensitive and quantitative tool for the identification of infections and the genetic variation of infectious illness. The conventional analysis techniques for particular gene sequences are either based on direct sequencing or hybridisation of DNA. The DNA hybridization approach is more widespread in the diagnostic lab than the direct sequencing approach because of its simplicity. The objective gene sequence of the DNA hybridization is determined using a DNA test that can generate a double-stranded hybrid, with its complementary high efficiency and highly high nucleic acid, in the presence of a combination of many diverse, non-complete nucleic acids. DNA probes are single-strand oligonucleotides marked with either radioactive or non-radioactive chemicals for the detection of signals of DNA hybridization[10].

Electrochemical biosensors

Electrochemical biosensors are among the standard DNA detection methods a prominent strategy for quick and sensitive determination of genetic disorder[7]. Due to their high specificity, speed, mobility, and cheap costs, electrical biosensors are intriguing for several decentralised clinical applications ranging from emergency room screening, bedside surveillance or home self-testing testing [6-8]. Traditionally, electrochemical devices have garnered the most focus in the development of bio sensors. These technologies provide a simple, affordable and yet accurate and sensitive patient diagnostic platform [4,5].

The word electrochemical biosensor is used to a molecular sensor that closely combines an element of biological identification with an electrode transducer. The aim is to transform the biological recognition event into a meaningful electrical signal. Future devices must connect great performance (especially high sensitivity and selectivity), high speed, miniaturisation and cheap cost to continue to make use of these developments and to remove DNA diagnostics from a central laboratory[6-9]. The use of these powerful equipment calls for imaginative efforts in developing new materials and new manufacturing techniques. Various traditional macromolecular material matrices for the creation of electrochemical biosensing devices have thus been presented. These electrochemical biosensors have safety concerns, include inadequate sensitivity, selectivity and limited stability of radioisotope, fluorescent and enzyme labels.

Nanostructured materials

Nanostructured materials in particular bring up new vistas for the use of electrochemical DNA biosensors. Recently, applications of nanostructured materials have been examined in electrochemical biosensors [11-20]. The nanostructured materials have been proven highly effective in the manufacture of electrochemical DNA biosensors. Many results on direct electrochemistry in redox active sample single strand DNA (ssDNA) immobilised on nanoparticles are known in literature [12,18-20]. These nanostructured modified electrodes not only boost the transducer's catalytic activity, they also increase enzymatic reaction on the surface of the electrode. The improved electrochemistry is because of the ability of

The distance from the redox site of a protein to the electrode reduces tiny nanoparticles as the transfer rate of electron is inversely dependent on the exponential distance between them. A number of Nanostructured materials, including metals, semiconductors, carbon or polymer species, nanofibres, nanoroids, nanocomb and nanometers have been intensively researched for their capacity to improve the response of biosensors [21-24]. Nanoparticles may be utilised to change biologic receptor molecules such as enzymes, antibodies, or oligonucleotides in several ways such as electrode surface modification (ODNs). A number of achievements of nanostructured materials have been attributed to their capacity to enhance bioassays' characteristics, enable miniaturisation and speed, reduce reagent and sample consumption, and enable diverse formats to be performed[12]. The use of nanostructured materials therefore enables bio sensor downsizing, microfluidic systems development and increased bioassay sensitivity.

CONLUSION

In developing electrochemical biosensors of DNA, nanostructured materials are opening up new frontiers. These DNA biosensors can serve to diagnose and monitor infectious diseases, to monitor medicinal products' pharmokinetics, to detect cancer and disease biomarkers, to analyse abuse drugs' breath, urine and blood, to find biological and chemical warfare agents and to monitor pathogens in the food industry, among other conceivable applications. The unique and desirable characteristics of nanostructured materials provide new prospects for the construction of advanced electroanalytic biosensing systems for DNA. Because of its large surface area, non-toxicity, biocompatibility and charge-sensitive conducting of nanoscale biosensing and bio-electronic devices, they operate as effective transducers. These electrochemical DNA devices based on nanostructured materials have a number of key features such as high sensitivity, superb selectivity, fast response time and rapid reversibility, and a massive integration potential of an adressing array that distinguishes them from other sensor technologies that are available today. The sensitivity of the sensor relies on the size and morphology of the nanomaterials concerned.

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