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Nanobiosensor - A Brief Overview

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Abstract

Nano biosensors are devices that compute a biochemical or biological hap by utilizing any optical, magnetic, or electronic technology through a compact probe.it is basically a quantifying system that uses biological interactions for evaluation of a material or constituent whose concentration is varying.

Keywords: Bioanalytes; Transducer; Detector; Nanowires; Acoustic; Biochemical

Introduction

A nano biosensor is a means of detecting biological agents such as antibodies, proteins, nucleic acids, pathogens, and metabolites [1]. Bioreceptor component of a nano biosensor serves as a template for the material or sample to be exposed for detection [2]. There are various materials that can be used as bioreceptor such as an antibody molecule is tested against a specific antigen [3] or on the other hand a protein is screened using its specific substrate [4] etc. Transducer system in a nano biosensor basically converts the initial biochemical signal produced as a result of interaction between bioanalyte and the bioreceptor into an electrical signal [5] which is then is received and amplified by the detector so that the related response can be read, studied and analyzed properly detected [6,7]. Nano biosensors are made up of nanomaterials or nano based constructs in dimensions from 1 to 100 nanometers [8]. Their nanosized layout makes them unique and very efficient to be used in biosensor technology's [9]. Nanomaterials not only enhance the sensing performance, but it also significantly improves the sensitivity and detection limits down to a single molecule [10]. The first nano biosensor was designed in 1999 at Georgia Institute of Technology which converted the biological action of various substances into measurable insights [11]. In addition, various recognition molecules are incorporated on the surface of nanowire or nanotubes to generate a nano biosensor with increased sensitivity [12].

Types of Nano biosensors

Nano biosensors are categorized on the basis of the type of substance or material being studied and the applied mechanism of signal transduction [13]. Classification of nano biosensors according to their sensing mechanism includes electrochemical, acoustic and magnetic [14,15] which are as follows:

Acoustic wave nano biosensors

They have been created in order to improve the sensing feedbacks so as to improve the overall limits associated with bio detection [16]. Acoustic based nano biosensors uses mechanical waves as a sensing mechanism to gather medical, biochemical, and biophysical information about the substance of interest [17]. It has the ability to detect changes in the mass, conductivity, elasticity etc. [18]

Electrochemical nano biosensors

With the use of improved electrical means, these sensors essentially function to accelerate or evaluate biochemical reactions [19]. The majority of these devices are made up of metallic nanoparticles. With the help of metallic nanoparticles, the chemical reactions between biomolecules can be quickly and efficiently carried out [20].

Magnetic nano biosensors

Magnetic nano biosensors make use of specially designed magnetic nanoparticles [21]. These are largely nanocrystalline based materials which can be used either separately or in combination with other conjugates [22]. In terms of biomedical application, these types of sensors are highly valuable. The super paramagnetic property of magnetic nanoparticles has been exploited in special devices such as superconducting quantum

interference devices (SQUID) for quick and easy detection of biological entities [23].

Nanotube Based Biosensors

Carbon nanotubes are one of the most widely used nanomaterials in biological studies, since their discovery in 1990's they have attracted mankind due to its some remarkable and marvelous properties the most essential of which are electronic conductivity, flexible physical geometric features, and the ever-dynamic physicomechanical properties, along with having high mechanical strength and folding abilities [24,25]. The most well-known sensing advancements are innovations in the development of glucose biosensors that incorporate the use of nanotubes as immobilizing surfaces for the enzyme glucose oxidase, which is used to estimate glucose from a variety of physiological fluids [26]. Single walled nanotubes have been successfully used for enzymatic detection of glucose [27].

Applications of Nano biosensors

Biomedical and diagnostic applications

Used for the detection of serum antigens and carcinogens, in the detection of disorders like diabetes, cancer, allergic responses, urinary tract bacterial infections, cancer [28]. DNA nano biosensors are effective tools for quick and accurate determination of pathogens, drug screening, diseases, genetic disorders etc. [29].

Applications in agriculture

Nano biosensors can detect soil pH, moisture, and a wide range of diseases, as well as insecticides, herbicides, pesticides, and fertilizers concentration in soil [30]. Nano biosensors, when used properly and in a controlled manner, can help to assist sustainable agriculture by increasing crop productivity [31].

Environmental applications

Nano biosensors have been used for the detection of environmental pollutants, toxic intermediates, heavy metals from waste streams, [32] for monitoring humidity level, ground water screening etc. [33].

Applications in industry

Nano biosensors also plays a huge role in quality control operations in food sector such as to measure carbohydrates, alcohols and acids [34]. In addition, nano biosensors can also be used during fermentation process during manufacturing of beer, yogurt, and soft drinks etc. [35].

Conclusion

Thus, nano biosensor technology proves to be effective in a wide range of applications such as in diagnostics, agriculture and environment. This technology promises effective and fast detection of molecules or constituents with high accuracy and sensitivity.

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