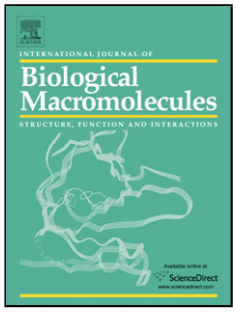

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Recent advances in carbon nanotube based electrochemical biosensors

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Running title: Carbon nanotube based biosensors: A comprehensive review

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Abstract

There is an increasing need for rapid, low cost, reusable, reliable and sensitive detection systems for diagnosing infectious diseases, metabolic disorders, rapidly advancing cancers and detecting the presence of environmental pollutants. Most traditional methods are invasive, slow, expensive and laborious, requiring highly specialized instruments. Introduction of biosensors with nanomaterials as transducers of signals have helped in removing the disadvantages associated with traditional detectors. The properties of high mechanical strength, better electrical conductivity and ability to serve as efficient signal transducers make carbon nanotubes (CNTs) ideal material for biosensor applications among the gamut of nanomaterials. Further, CNTs with their high surface areas, easily functionalizable surfaces for receptor immobilization are gaining importance in the construction of biosensors. The expanding field of CNTs bridges the physical sciences with biology, as chemical methods are employed to develop novel tools and platforms for understanding biological systems, in disease diagnosis and treatment. This review presents recent advances in surface functionalization of CNTs necessary for immobilization of enzymes and antibodies for biosensor applications and the methodologies used for the detection of a number of chemical and biological species. The review ends with a speculation on future prospects for CNTs in biology and medicine.

Keywords: Carbon nanotubes; Functionalization of CNTs; Enzymes; DNA; Biosensors;

1. Introduction

Carbon nanotubes originally described in 1991 by Sumio Iijima [1], have been found to be associated with many useful and unique properties [2]. CNTs are divided into two types namely, single-walled carbon nanotubes (SWCNT) and multi-walled carbon nanotubes (MWCNT) as seen in Fig 1. Rolling a graphene sheet into a cylinder results in SWCNT, on the other hand arrangement of concentric graphene cylinders with an interlayer space of 0.34 nm leads to formation of MWCNT. The properties of CNTs are a