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Electrochemical DNA sensors and aptasensors based on electropolymerized materials and polyelectrolyte complexes

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ABSTRACT

DNA sensors based on oligonucleotides and aptamers immobilized using electropolymerization and layer-by-layer assembling are reviewed. The conditions of electropolymerization and the role of electrosynthesized layers are considered for polyaniline, polypyrrole, polythiophene, polyphenazines and their derivatives with particular attention to immobilization of bioreceptors and signal detection principles. The performance of DNA sensors for hybridization detection and for the determination of low-molecular intercalators and DNA damaging factors is reviewed. Besides, the composition of polyelectrolyte complexes utilizing DNA receptors are considered depending on the analyte nature and functions of polyionic components and auxiliary reagents used for surface layer coatings.

Contents

1. Introduction

The interest to the DNA sensors has been dramatically increased in the past decades due to great significance of their application including detection of hybridization events, DNA damage and antitumor drugs analysis [1,2]. Electrochemical transducers offer broad opportunities in DNA sensor design due to simple experiment protocols, inexpensive and mostly commercially available equipment. Together with well-developed theory of electrochemical phenomena, these advantages result in intensive progress in electrochemical DNA sensors development.

The use of electrochemical transduction principles has a natural limitation in rather low electrochemical activity of DNA molecules, which can be detected only with special measurement technique like differential pulse voltammentry (DPV) and adsorptive stripping voltammetry and chronoamperometry on mercury or carbon electrodes [3]. Recently, new approaches have been suggested to overcome this limitation by special design of appropriate transducer. Electropolymerized materials and polyelectrolyte complexes implementing DNA receptor elements are of special importance due to advantages they possess, i.e. variety of electrochemical characteristics, easy implementation of the DNA probes, preservation of native structure of DNA, high reproducibility of the biosensor characteristics and compatibility with different transducer types with no respect of their dimensions and shape.

In this review, electrochemical DNA sensors based on electropolymerized materials and polyelectrolyte complexes are

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