Mini Review

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Application of screen-printed carbon electrode as an electrochemical transducer in biosensors

Abstract

Screen printed electrodes have been extensively employed as an economical transducer substrate for electrochemical biosensing applications due to their small size, easiness of mass production and the possibility of use with portable devices which facilitates *in situ* applications. Carbon inks can be widely modified by the addition of materials and/or molecules and this versatility confers the capacity to be used for the purposes of food, agricultural, environmental and biomedical analyses.

Keywords: screen printed electrode, carbon, biosensing

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Introduction

Great interest has been directed to the screen printing technology for biosensing applications. Screen-printed electrodes (SPEs) possess as major advantage over the traditional electrodes the possibility of use in miniaturized systems, whose applications demand portable devices. Besides the possibility to perform *in situ* analyses, the easiness of mass production makes these electrodes very interesting for the market.

Fabrication

Usually, the SPEs consist of a three-electrode configuration (working, counter- and reference electrodes). Carbon ink is painted onto one extremity of the conductive tracks to form the working and counter electrodes, and the reference electrode is commonly based on silver electroactive tracts. An insulating film is glued to the exposed tracts and between the electrodes to avoid short-circuit. The screen-printed carbon electrodes (SPCEs) contain a carbon conductive ink that is chemically inert, organic solvents, additives and some binding components.[1,2]

Pre-treatment

Since the SPCE possess insulator additives to improve the adhesion of carbon ink on the support, the pre-treatment of these electrodes is considered a key point to overcome its limited electron transfer kinetics at the interface with the electrolyte. In order to activate the edge planes of the SPCE, many techniques have been considered to enhance the carbon electro activity (i.e. thermal, chemical and mechanical treatments), although the electrochemical processes are the most commonly used. Sundaresan et al.,[3] performed 10 cycles of cyclic voltammetry in 0.05 M phosphate buffer in a potential range from -0.5 to 2.0 V *vs* Ag/AgCl. Pan et al.,[4] applied a fixed -1.2 V *vs* Ag/AgCl potential during 20 s to an electrode containing a drop of 0.1M NaOH.

Applications in electrochemical biosensing

The final step to produce an SPCE fit for purpose is the modification (functionalization) of the working electrode surface. The target analyte drives the choice of molecules or biomolecules with specific reactivity towards it to be attached. Table 1 shows some recent applications of SPCE regarding the biosensing of molecules of medical, environmental and food interests.

Table 1 Recent applications of SPCE as electrochemical transducer in biosensors

Application	Target analyte	Molecule of recognition	Technique of detection	Reference
Medical diagnosis	Cardiac troponin I Japanese encephalitis virus (JEV)	5′-amine modified Tro4 aptamer Anti-JEV antibodies	Chronoamperometry Electrochemical Impedance Spectroscopy	5,6
Environment monitoring	Cathecol Bisphenol A	Laccase Dendritic platinum NPs	Chronopotentiometry Cyclic voltammetry	7,8
Food analysis	Fructose Ethyl carbamate	Graphite NPs O-aminophenol	Chronoamperometry Cyclic voltammetry	9,10

Conclusion

The possibility of modification of SPCE to detect various molecules associated to its miniaturized dimensions and low cost of production has been extensively exploited, as reported in the literature, for the development of versatile electrochemical biosensors. The electro activity of carbon has been improved by different treatments making it suitable for application as a transducer in electroanalysis manly towards the detection of biological molecules.

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Conflicts of interest

There are no conflicts of interest.

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