

Screen-Printed Electrodes: Versatile Transducers In Nano-Biosensor Development

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The screen-printing microfabrication technology is nowadays well established for the production of thick-film electrodes (**screen-printed electrodes -SPEs-**) used as biosensor transducers. This process implies the sequential deposition of layers of different, conductive or non conductive, inks on a variety of inert plastics or alumina substrates, followed by a drying and/or firing process. Through this technology the mass production of strip solid electrodes has been achieved.

SPEs are inexpensive and reproducible so they are used as disposable devices. Single use SPEs avoid the memory effect between consecutive measurements and the common regeneration processes carried out with solid electrodes to solve electrode fouling. Other features that these electrodes exhibit are related to the **miniaturization** of the electrochemical cell: small sample volumes such as 40 μL are enough to develop the electrochemical assay. Their **ease of handling** and manipulation offer the possibility of achieving **decentralized analytical determinations** remote from the laboratory. Therefore, a significant research for their use in the fabrication of **biosensors** is being accomplished. Up to date the most commercially exploited of these devices has been the personal glucose biosensor used by diabetics, however new developments are continuously brought to life.

In this work a SPE with the traditional three-electrode configuration printed on the same strip is used as transducer in the development of **disposable electrochemical biosensors** using a novel enzymatic substrate:

Alkaline phosphatase (AP) is one of the most used enzymatic labels for the development of ELISAs, immunosensors, DNA hybridization assays, etc. This enzyme catalyzes the dephosphorylation of a substrate into a detectable product usually quantified by optical or electrochemical measurements. This work is based on using **3-indoxyl phosphate**, a substrate that produces a compound able to reduce **silver ions** in solution into a metallic deposit which is localized where the enzymatic label AP is attached; then silver stripping allows AP detection. This methodology provides an enhanced procedure of detecting an analyte via this metallic AP-catalyzed deposition.

Following this strategy, this work describes the development of a **genosensor** for the detection of virulence nucleic acid determinants of autolysin gene (present on *Streptococcus pneumoniae*) and an **immunosensor** for the detection of Prostate Specific Antigen (*PSA*), using a SPE as transducer and anodic stripping voltammetry as detection method.

The use of **nanomaterials** in the development of electrochemical biosensors is leading to improved devices that show enhanced analytical features. Since the discovery of **carbon nanotubes (CNTs)** there has been enormous interest in exploiting their unique mechanical, chemical and physical properties to develop (bio)sensors. CNTs show good electrocatalytic activity toward some electroactive molecules and usually good electrochemical behaviour; also, high proteic material adsorption ability has been shown by this nanomaterial. All this makes CNTs suitable molecules to be used in biosensor technology.

This work shows the nanostructuring of SPEs with CNTs and **nanogold**, and the improved electrochemical characteristics of these new analytical devices due to an enhancement of the effective area of the electrode, due to the high adsorption properties of these nanomaterials and due to the good electronic transfer properties.