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Sol-gel biomimetic material designed to target CEA cancer biomarker

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Introduction

Carcinoembryonic antigen (CEA) is an important tumor marker responsible for clinical diagnosis of over 95% of all colon tumors, 50% of breast tumors, as well as tumors of the lung cancer or ovarian carcinoma [1]. The detection of CEA levels in biological samples plays an important role in the pre-diagnosis evaluation and in the follow-up examination during therapy stage [2]. The most common tool for the analysis of CEA in hospitals and clinical laboratories relies on ELISA-based procedures using antibodies as capturing probe. The overall principal offers the selectivity and sensitivity out coming from the use of antibodies, but it could be further improved by assembling the biosensors over a receptor platform and establishing a label-free measure by electrical impedance spectroscopy (EIS). Thus, the present work proposes the development of an immunosensor for CEA.

Materials and Methods

Electrochemical signals were measured in a Methrom Autolab potentiostat/galvanostat (Autolab PGSTAT302N) interfaced to a computer and controlled by NOVA 1.9 software. The chemical modification of the surface of the conductive glass was characterized by Raman spectroscopy with confocal microscopy (Thermo Scientific).

The immunosensor was assembled by modifying conductive glass (with ITO) with an amino silane compound (APTES), activating the antibody via carbodiimide chemistry (EDAC/NHS) and binding the antibody to the amine surface over the ITO glass. The performance of the imunosensor was evaluated by electrochemical techniques, namely electrochemical impedance spectroscopy (EIS) and square wave voltammetry (SVW).

Results and discussion

The immunosensor made with an optimized composition displayed linear behavior against CEA concentration by EIS and SWV techniques. The corresponding linear ranges were 0.502-1.5 and 0.252-1.5ng/mL, with detection limits of 0.417 and 0.043 ng/mL, respectively. Overall, the obtained device may be potential method to apply for screening CEA in point-of-care due to the simplicity of fabrication, short time response, low cost and good sensitivity when compared to other analytical techniques, such as ELISA assays.

[1] Kemmegne-Mbouguen, J. et al., 2014, Int. J. Electrochem. Sci., **9**, 478 – 492.

[2] Liua, M. et al., 2010, Talanta, **81**, 1625–1629.

Keywords: Cancer biomarker, CEA, antibody, biosensors, sol-gel.

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