Tailored electrochemical nano-immunosensor for anti-p53 autoantibodies based on cerium oxide doped PEDOT

Andrés F. Cruz-Pacheco
Jennifer Quinchia, Jahir Orozco
Max Planck Tandem Group in Nanobioengineering, Institute of Chemistry, Faculty of Natural and Exact Sciencies, University of Antioquia, Complejo Ruta N, Calle 67 No. 52-20, Medellín 050010, Colombia
grupotandem.nanobioe@udea.edu.co

Abstract

Nano-immunosensors have the potential for the rapid, sensitive, and specific diagnosis of diseases such as cancer by detecting related biomarkers even at early stages, for instance, by detecting anti-p53 autoantibodies (aabs) produced by the individual's immune system against tumor-associated antigens several months or even years before the onset of clinical symptoms of the disease [1]. In this context, a novel and simple label-free electrochemical nano-immunosensor was developed for the selective and specific detection of anti-p53 aabs [2]. The immunoassay combined the extraordinary conductivity of poly(3,4-ethylenedioxythiophene) (PEDOT) electropolymerized *in situ* on screen-printed gold electrodes (SPAuE) and the direct functionalization of small cerium oxide (CeO_2) nanoparticles embedded in the polymeric matrix with p53 antigen. The individual nanostructures and each step of the nano-immunosensor architecture were extensively characterized in chemical, physical, and electrochemical properties by DLS, ELS, TEM, EDX, UV-Vis, FT-IR, XRD and electrochemical techniques. Under optimal conditions, the nano-immunosensor selectively and specifically detected anti-p53 aabs by differential pulse voltammetry at clinically relevant concentrations in less than 1 h, with high sensitivity and a limit of detection (LOD) of 3.2 pg mL^{-1} and with a shelf life of four weeks. Overall, the biofunctional nanocomposite-based immunosensing system assembled on SPAuE demonstrated excellent analytical performance even in spiked human serum samples, contributing to future ultrasensitive detection systems for cancer-related biomarker screening.

References

[1] Quinchia J, Echeverri D, Cruz-Pacheco A F, Maldonado M E and Orozco J A, Micromachines, 11 (2020) 1
[2] Cruz-Pacheco A F, Quinchia J and Orozco J, Microchim. Acta, 189 (2022) 228

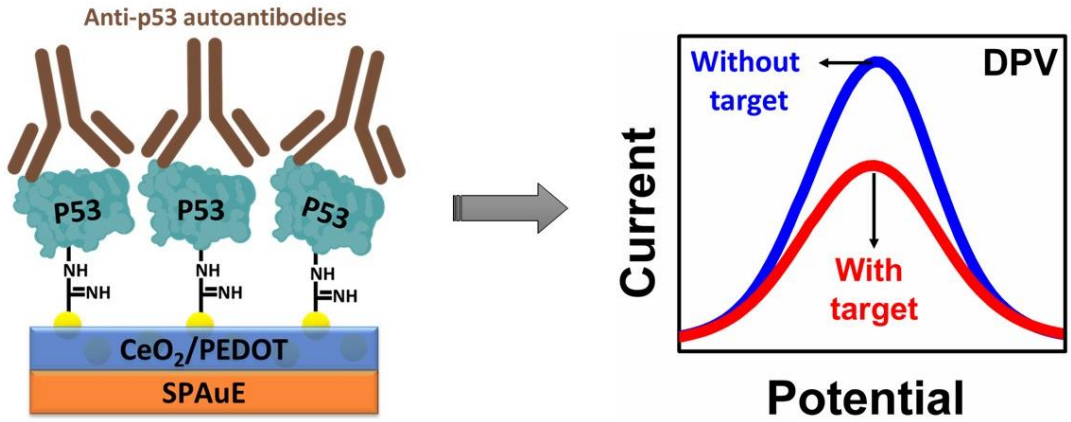

Figure 1: Scheme of CeO_2-doped PEDOT-based nano-immunosensor for detection of anti-p53 autoantibodies by DPV using PBS 1X pH 7.4 solution containing 5 mM $[Fe(CN)_6]^{3-/4-}$ as a redox mediator.