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Development of Nanostructured Electrochemical Sensor for the Detection of 17α – Ethinylestradiol in Aquaculture

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Extended Abstract

The presence of hormones in aquatic environments, such in aquaculture, is a potential threat to ecosystems and human health and safety (Farre et al., 2008). Many of these molecules have the ability to affect the endocrinal systems of organisms, being classified as endocrine disrupting compounds (EDCs). One example of EDC is 17α- ethinylestradiol (EE2), a synthetic estrogen widely used as oral contraceptive with high estrogenic potency (Aris et al., 2014). EE2 has already been found at trace level in surface and drinking water in many countries, causing deep concern (Benotti et al., 2009 and Sodré et al., 2010), however, there are only a few studies found in literature regarding its electrochemical detection. In this context, the present work aims at the development of a novel nanostructured electrochemical sensor for EE2 detection in standard and real samples, focusing on the fabrication of versatile devices of low-cost and high sensitivity. Layer-by-layer (LbL) films of chitosan (Chi) and multi-walled carbon nanotubes (MWCNTs) deposited on fluorine doped tin oxide (FTO) substrate were used as platform for the EE2 electrochemical detection. The physicochemical properties of the films were evaluated by atomic force microscopy (AFM) and Fourier transform infrared spectroscopy (FTIR). Cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and square-wave voltammetry (SWV) were carried out to evaluate the EE2 electrochemical behavior. The results show that the charge transfer resistance decreases as the amount of carbon nanotubes (bilayers) increases in the film, due to its excellent conductive properties. Cyclic voltammograms showed that the electrode modified with three bilayers of Chi/MWCNTs was suitable for EE2 detection, revealing an irreversible and adsorption-controlled electrochemical oxidation process. EE2 oxidation occurs through an EC-EC mechanism which includes two electron transfer and chemical steps. The sensorial response has a linear range from 0.05 to 20 μmol L^{-1}, with a detection limit of 0.09 μmol L−1 (S/N = 3), presenting good reproducibility with relative standard deviation (RSD) equal to 3,2%.

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