Accepted Manuscript

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PII: S0013-4686(18)30108-7

DOI: 10.1016/j.electacta.2018.01.077

Reference: EA 31059

To appear in: *Electrochimica Acta*

Received Date: 31 July 2017

Revised Date: 9 November 2017

Accepted Date: 11 January 2018

Please cite this article as: L.C. Almeida, J.P. Correia, A.S. Viana, Electrochemical and optical characterization of thin polydopamine films on carbon surfaces for enzymatic sensors, *Electrochimica Acta* (2018), doi: 10.1016/j.electacta.2018.01.077.

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Electrochemical and optical characterization of thin polydopamine films on carbon surfaces for enzymatic sensors

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Abstract

The electrochemistry, optical properties, wettability and morphology of polydopamine (PDA) thin films were extensively studied on carbon electrodes, in order to evaluate their potential to be used as electrochemical biosensor interfaces. To fulfil this purpose, several PDA films with different thicknesses were allowed to grow spontaneously and their electrochemical stability and coverage of active quinone/hydroquinone groups were assessed by cyclic voltammetry. Ellipsometry has been used to evaluate the dielectric properties of PDA, and film thickness increase with the deposition time on glassy carbon electrodes. Atomic Force Microscopy corroborates film thickness and revealed the formation of uniform coatings for all dopamine incubation times. PDA wettability validates the presence of hydrophilic quinone/hydroquinone. Electrochemical and optical characterization of the modified electrodes points to the formation of a poorly conducting polymeric matrix, yet allowing the charge transfer process of electroactive probes, for 3±1 nm thick films, proving their applicability as electrochemical transducers. The catalytic activity of immobilized Glucose Oxidase or Laccase on graphite/PDA electrodes were validated against glucose and 2,2′-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS), respectively. The analytical parameters are particularly promising for Laccase modified electrodes

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