Inkjet-printed electrochemically reduced graphene oxide microelectrode as a platform for HT-2 mycotoxin immunoenzymatic biosensing

Lei Zhao [a,c]
Jiri Kudr [a,b], Emily P. Nguyen [a,] Henri Arola [d] , Tarja K. Nevanen [d], Vojtech Adam [b,e], Ondrej Zitka [b,e], Arben Merkoçi [a,f*]

[a] *Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and The Barcelona Institute of Science and Technology, Bellaterra, Spain*
[b] *Department of Chemistry and Biochemistry, Mendel University in Brno, Zemedelska 1, Brno, CZ-613 00, Czech Republic*
[c] *Department of Chemical Engineering, School of Engineering, UAB, Bellaterra, Spain*
[d] *VTT Technical Research Centre of Finland, Espoo, Finland*
[e] *Central European Institute of Technology, Brno University of Technology, Brno, Czech Republic*
[f] *ICREA – Institucio Catalana de Recerca i Estudis Avançats, Barcelona*

arben.merkoçi@icn2.cat

The design and application of an inkjet-printed electrochemically reduced graphene oxide microelectrode for HT-2 mycotoxin immunoenzymatic biosensing is reported. A water-based graphene oxide ink was first formulated and single-drop line working microelectrodes were inkjet-printed onto poly(ethylene 2,6-naphthalate) substrates, with dimensions of 78 µm in width and 30 nm in height after solvent evaporation. The printed graphene oxide microelectrodes were electrochemically reduced and characterized by Raman and X-ray photoelectron spectroscopy spectroscopies in addition to microscopies. Through optimization of the electrochemical reduction parameters, differential pulse voltammetry was performed to examine the sensing of 1-naphthol (1-N), where it was revealed that reduction times had significant effects on electrode performance. The developed microelectrodes were then used as an immunoenzymatic biosensor for the detection of HT-2 mycotoxin based on carbodiimide linking of the microelectrode surface and HT-2 toxin antigen binding fragment of antibody (anti-HT2 (10) Fab). The HT-2 toxin and anti-HT2 (10) Fab reaction was reported by anti-HT2 immune complex single-chain variable fragment of antibody fused with alkaline phosphatase (anti-IC-HT2 scFv-ALP) which is able to produce an electroactive reporter – 1-N. The biosensor showed detection limits of 1.6 ng · mL^{-1} and a linear dynamic range of 6.3 – 100.0 ng · mL^{-1} within a 5 min incubation with 1-naphthyl phosphate (1-NP) substrate.

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