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Carbon-Based Electrochemical Detection of Pharmaceuticals from Water

Authors : M. Ardelean, F. Manea, A. Pop, J. Schoonman

Abstract : The presence of pharmaceuticals in the environment and especially in water has gained increasing attention. They are included in emerging class of pollutants, and for most of them, legal limits have not been set-up due to their impact on human health and ecosystem was not determined and/or there is not the advanced analytical method for their quantification. In this context, the development of various advanced analytical methods for the quantification of pharmaceuticals in water is required. The electrochemical methods are known to exhibit the great potential for high-performance analytical methods but their performance is in direct relation to the electrode material and the operating techniques. In this study, two types of carbon-based electrodes materials, i.e., boron-doped diamond (BDD) and carbon nanofiber (CNF)-epoxy composite electrodes have been investigated through voltammetric techniques for the detection of naproxen in water. The comparative electrochemical behavior of naproxen (NPX) on both BDD and CNF electrodes was studied by cyclic voltammetry, and the well-defined peak corresponding to NPX oxidation was found for each electrode. NPX oxidation occurred on BDD electrode at the potential value of about +1.4 V/SCE (saturated calomel electrode) and at about +1.2 V/SCE for CNF electrode. The sensitivities for NPX detection were similar for both carbon-based electrode and thus, CNF electrode exhibited superiority in relation to the detection potential. Differential-pulsed voltammetry (DPV) and square-wave voltammetry (SWV) techniques were exploited to improve the electroanalytical performance for the NPX detection, and the best results related to the sensitivity of 9.959 µA·µM⁻¹ were achieved using DPV. In addition, the simultaneous detection of NPX and fluoxetine -a very common antidepressive drug, also present in water, was studied using CNF electrode and very good results were obtained. The detection potential values that allowed a good separation of the detection signals together with the good sensitivities were appropriate for the simultaneous detection of both tested pharmaceuticals. These results reclaim CNF electrode as a valuable tool for the individual/simultaneous detection of pharmaceuticals in water.

Keywords : boron-doped diamond electrode, carbon nanofiber-epoxy composite electrode, emerging pollutans, pharmaceuticals
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