Accepted Manuscript

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PII: S1572-6657(18)30591-5
DOI: doi:10.1016/j.jelechem.2018.09.010
Reference: JEAC 12593

To appear in: *Journal of Electroanalytical Chemistry*

Received date: 5 June 2018
Revised date: 31 August 2018
Accepted date: 4 September 2018

Please cite this article as: Elsa Maria Materon, Ademar Wong, Orlando Fatibello-Filho, Ronaldo Censi Faria , Development of a simple electrochemical sensor for the simultaneous detection of anticancer drugs. Jeac (2018), doi:10.1016/j.jelechem.2018.09.010

Development of a simple electrochemical sensor for the simultaneous detection of anticancer drugs

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Abstract

The most used drug cocktail for the treatment of metastatic or advanced types of cancers is the combination of DOX and MTX. On one hand, in the chemotherapy, it is crucially important to detect and maintain a good concentration of the anticancer drugs in the patient's body, in order to prevent serious side effects of the drugs. Whereas, on the other hand, these drugs are excreted in faeces and urine from the patient and can contaminate the aquatic environments, which may cause several health hazards. In view of that, an electrochemical sensor was proposed for the simultaneous determination of DOX and MTX using carbon black (CB), cooper nanoparticles (CuNPs) and Nafion modified glassy carbon electrode. Morphological and chemical characterization of these materials were performed using FEG-SEM images and EDS analysis. The modified electrode exhibited good catalytic activity for electrochemical oxidation in square wave voltammetry, with redox potential of 0.69 V and 0.93 V for DOX and MTX, respectively. Under optimized conditions, linear response range of 4.5×10^{-7} to 5.1×10^{-6} mol L^{-1} and 2.2×10^{-6} to 2.5×10^{-5} mol L^{-1} with limit of detection of 2.4×10^{-8} mol L^{-1} and 9.0×10^{-8} mol L^{-1} were achieved for DOX and MTX, respectively. Finally, the CuNPs-CB-Nafion/GCE sensor was successfully applied toward the determination of DOX and MTX in biological matrix (human urine samples) and within the environment (water river samples), where a spike recovery of nearly 100% was obtained.

Keywords: carbon black; methotrexate; doxorubicin; antitumoral drugs; simultaneous detection.