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RESEARCH PAPER

Multiwall carbon nanotubes decorated with $FeCr_2O_4$, a new selective electrochemical sensor for amoxicillin determination

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Abstract $FeCr_2O_4$ nanoparticles were synthesized and then multiwall carbon nanotubes (MWCNTs) were decorated with $FeCr_2O_4$ nanoparticles. The new nanoparticles were characterized with different techniques such as vibrating sample magnetometer, Fourier transform infrared spectroscopy, scanning surface microscopy, transmission electron microscopy (TEM), atomic force microscopy (AFM), and electrochemical impedance spectroscopy. The results of the study confirm that the particles are pure $FeCr_2O_4$–MWCNTs with a cubic structure. No diffraction peaks of other impurities such as FeO or Cr_2O_3 were observed. The diffractive peaks of $FeCr_2O_4$–MWCNTs are broadened, implying that the crystalline size of $FeCr_2O_4$–MWCNTs particles is quite small. The mean particle size of $FeCr_2O_4$–MWCNTs calculated by Scherrer equation is about 25 nm, whereas the existence of particles with less than 30 nm size at $FeCr_2O_4$–MWCNTs is clearly reflected in 2D and 3D AFM images. The TEM image confirms that the spaghetti-like $FeCr_2O_4$–MWCNTs formed a porous structure. The synthesized $FeCr_2O_4$–MWCNTs nanoparticles could be used as a new electrocatalysis for voltammetric determination of amoxicillin (AMC). Under the optimized conditions at pH 7.5 and in differential pulse voltammetry, the oxidation peak current of AMC at the surface of the mediator has two linear dynamic ranges including 0.1–10.0 and 10.0–70.0 μmol L^{-1}. The detection limit of 0.05 μmol L^{-1} was achieved. The influence of potential interfering compounds on the selectivity was studied. Finally, the modified electrode showed good sensitivity, selectivity, and stability for the determination of AMC in real samples.

Keywords $FeCr_2O_4$ nanoparticles · Modified multiwall carbon nanotubes · Amoxicillin determination · Electrocatalytic effect · Voltammetry

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Introduction

Amoxicillin (AMC) (D-α-amino-*p*-hydroxybenzyl penicillin trihydrate), is one of the most frequently used β-lactam antibiotics in the world and its employed to treat infectious humans and animals diseases and to enhance growth and yield in agriculture (Goodman-Hillman et al. 1996; Reynold 1993). β-Lactam antibiotics presents a structure based on a β-lactam ring responsible for the antibacterial activity and variable side chains that account for the major differences in their chemical and pharmacological properties. After a single oral dose of 500 mg, 60–86 % of the drug is excreted unchanged in the urine during the first 6 h (Garcia-Reiriz et al. 2007).

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