Screen Printed Electrodes Modified with Carboxylated Multiwall Carbon Nanotubes for the Analysis of Hydroquinone and Ascorbic Acid

Rui Gusmão[a,b], Marta Fortes[a], Raquel Oliveira[a], Dulce Geraldo[a], Fátima Bento[a], Fernanda Proença[a], Conceição Paiva[b]

[a]*Centro de Química, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal*
[b]*Instituto de Polímeros e Compósitos/I3N, Universidade do Minho, Campus de Azurem, 4800-058 Guimarães, Portugal*

Carbon nanotubes (CNT) have demonstrated to be advantageous in electrochemical applications such as in energy storage devices and sensors. The presence of oxygenated carbon species, especially carboxylic acid moieties, together with metallic impurities are identified as chief factors for the catalytic properties of CNTs. The oxygen-containing groups are introduced randomly at the surface of CNTs by strong mineral acid treatment. These factors can be of extreme importance for the construction of biosensors based on carbon nanomaterials.
In this study, multiwalled carbon nanotubes (MWCNTs) were chemically shortened and carboxylated by treatment with nitric acid for metal impurities removalusing a method described in the literature, originating MWCNT-COOH. Ethanol suspensions of MWCNT-COOH at different concentrations were used to modify the surfaces of commercially available screen-printed electrodes (SPEs).
The SPEs modification with MWCNT-COOH was optimised and it was applied in order to obtain a reproducible electrochemical response. The morphology of the MWCNT-COOH modified SPEs was characterized by Scanning Electron Microscopy. Characterization of the CNT film generated on the surface of the working electrode and stability studies were carried out with potassium hexacyanoferrate. Results are compared with those obtained for commercially available carbon SPE and SPE-MWCNT.
Effect of solution acidity on the peak current and potential of the substances was studied at pH 3 and 7 where a correlation with the dissociation degree of carboxyl groups at the MWCNTs on the electrode surface occurs.
The catalytic properties of the MWCNT-COOH-modified SPEs as well as their analytical advantages as voltammetric detectors are discussed through the analysis of ascorbic acid (AA) and hydroquinone (HQ).

Keywords: Carboxylated Multi-Wall Carbon Nanotubes, Hydroquinone, Ascorbic Acid, Potassium Hexacyanoferrate, Screen Printed Electrode.