Metal- and metal-oxide modified multiwalled carbon nanotubes based determination of glucose

Valéria Guzsvány[1], Kurt Kalcher[4], Zoltán Kónya[2,3*]

[1]University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, Trg D. Obradovića 3, 21000 Novi Sad, R. Serbia
[2]University of Szeged, Department of Applied and Environmental Chemistry, Rerrich Béla tér 1, 6720 Szeged, Hungary
[3]MTA-SZTE Reaction Kinetics and Surface Chemistry Research Group, 6720 Szeged, Rerrich Béla tér 1
[4]Institute of Chemistry-Analytical Chemistry, Karl-Franzens University Graz, Universitaetsplatz 1, 8010 Graz, Austria

In this comparative study a traditional, paraffin oil and graphite powder based carbon paste electrode (CPE) was surface modified with multiwalled carbon nanotubes (MWCNT) and with composite nanomaterials of MnO_2-MWCNT and Pt-MWCNT by simply drop coating method for obtaining easy to prepare and reliable voltammetric sensors for H_2O_2 determination in different samples. The SEM/EDS characterization of the composite nanomaterials confirmed that the mediators are randomly distributed on the surface of the MWCNTs, and in both cases represent approximately 5% of the nanocomposites. Cyclic voltammetric investigations were performed in acetate (pH 4.50), phosphate (pH 7.50) and borate (pH 9.18) buffers to determine/compare the basic electrochemical behaviors and to select the working potentials suitable for hydrodynamic chronoamperometric determination of H_2O_2 under different circumstances. The CV responses showed that in slightly alkaline media all four electrodes are applicable, but with different efficiency at different potential values, with favorized reduction signal of H_2O_2 and Pt-MWCNT/CPE and oxidation signal at MnO_2-MWCNT/CPE. The reproducibility of the responses is different; in the case of MnO_2-MWCNT/CPE it is much lower, which demands additional electrochemical conditioning step. Additional remarkable differences were obtained in the case of two composite nanomaterial modified electrodes at pH 4.50 and 9.18. In the acidic media the MnO_2-MWCNT/CPE was not suitable, but in basic supporting electrolyte showed promising behavior, while in the case of the Pt-MWCNT/CPE the signals are much promising in the acidic media with limited possibilities for applications at pH 9.18. The analytical methods were optimized applying, mainly, the Pt-MWCNT/CPE, in term of selection of the appropriate pH, and working potentials for hydrodynamic chronoamperometric determination of H_2O_2 in milk samples and in photocatalytic samples where the disappearance of the H_2O_2 was determined. Additionally, the Pt-MWCNT/CPE was modified with glucose oxidase and the glucose content was successfully determined in pollen sample.