

Simultaneous Detection of Dopamine and Uric Acid in the Presence of Ascorbic Acid at Physiological Level Using Anodized Multiwalled Carbon Nanotube-Polydimethylsiloxane Paste Electrode

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Abstract : A carbon paste electrode (CPE) composed of Multiwalled Carbon Nanotube (MWCNT) conducting particle and Polydimethylsiloxane (PDMS) binder was used for simultaneous detection of Dopamine (DA) and Uric Acid (UA) in the presence of Ascorbic Acid (AA) at physiological level. The MWCNT-PDMS CPE was initially activated via potentiodynamic cycling in a basic (NaOH) solution, which resulted in enhanced electrochemical properties. Electrochemical Impedance Spectroscopy measurements revealed a significantly lower charge transfer resistance (R_{ct}) for the OH--activated MWCNT-PDMS CPE ($R_{ct} = 5.08\text{k}\Omega$) as compared to buffer (pH 7)-activated MWCNT-PDMS CPE ($R_{ct} = 25.9\text{k}\Omega$). Reversibility analysis of Fe(CN) $_6^{3-/4-}$ redox couple of both Buffer-Activated CPE and OH--Activated CPE showed that the OH--Activated CPE have peak current ratio (I_a/I_c) of 1.11 at 100mV/s while 2.12 for the Buffer-Activated CPE; this showed an electrochemically reversible behavior for Fe(CN) $_6^{3-/4-}$ redox couple even at relatively fast scan rate using the OH--activated CPE. Enhanced voltammetric signal for DA and significant peak separation between DA and UA was obtained using the OH--activated MWCNT-PDMS CPE in the presence of 50 μM AA via Differential Pulse Voltammetry technique. The anodic peak currents which appeared at 0.263V and 0.414 V were linearly increasing with increasing concentrations of DA and UA, respectively. The linear ranges were obtained at 25 μM - 100 μM for both DA and UA. The detection limit was determined to be 3.86 μM for DA and 5.61 μM for UA. These results indicate a practical approach in the simultaneous detection of important bio-organic molecules using a simple CPE composed of MWCNT and PDMS with base anodization as activation technique.

Keywords : anodization, ascorbic acid, carbon paste electrodes, dopamine, uric acid

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