

A Study on Voltametric Electro-Kinetic Mechanism of Catechol at ℓ -Glutamic Acid- Carbon Paste Sensor

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Abstract

Quinones and quinoles, the pervasive components of living organism, perform different biochemical and physiological activities. These compounds have found their widespread applications as life saving drugs in cancer chemotherapy, anti-oxidant, anti bacterial and antifungal agents. These contribute as components of biological electron transfer chains located indifferent body parts. Electrochemical redox behavior of catechol using cyclic and differential pulse voltammetry at the surface of ℓ -glutamic acid modified carbon paste sensor was observed quite sensitive. There was a remarkable increase in the magnitude of both peak currents of catechol at the surface of modified electrode as compared to that of bare carbon paste electrode. Optimizations of working parameters for both techniques have been performed to perk up the working efficiency during experimentation. The electrochemical process occurs under both the diffusion and adsorption controlled conditions. The kinetic parameters such as heterogeneous electron transfer rate constant for electrode process (K_h), diffusion coefficient (D), standard rate constant of surface reaction (k^0), electron transfer coefficient (α) and the average surface concentrations of electro-active species (χ_1 & χ_2) at the electro-chemical barriers catechol/o-quinone radical and o-quinone radical/o-quinone were calculated. The calculated value of K_h lie in close vicinity to limiting value of a complete irreversible process and in far range of quasi-reversible process. In the higher range of applied scan rates at lower potentials of the used potential window, the forward scan revealed the formation of well stable reaction intermediate, at relatively slower rate. This is the rate determining step of the oxidation process but in case of reduction pulse of the same scan rate, there is no indication of any reduction intermediate moieties. The chemical process during electrochemical oxidation of catechol follows pseudo first order kinetics. Furthermore, a two step oxidation, Electronic-Chemical-Electronic-Chemical reactions (ECEC) mechanism has been proposed and single step reduction has been observed for the coupled redox process at the sensor/analyte interface.

Keywords: Cyclic and Differential Pulse Voltametry, Kinetic Parameters, ℓ -Glutamic Acid, Modified Graphite Sensor, Redox Mechanism