Development of silafluorene modified electrode for electrochemical detection of the insecticide - carbofuran

P.A.D.U. Chathuranga[1], H.M.A.M.C. Herath[2] , A.N. Navaratne[3]

Abstract

Carbofuran which is a pesticide, has been in use for several decades in the agriculture field. Accumulation of carbofuran and its metabolite products in the environment pose a major health hazard to humans and the ecosystem. Therefore, quantitative determination of this pesticide in the environment is of utmost significance. Currently available advanced and costly methods like HPLC and gas chromatography have detection limits of 0.9ppb and 0.1ppb for carbofuran respectively. The main objectives of this research were, to develop cost effective and selective electro-analytical method by using silafluorene modified electrode sensitive to carbofuran, to compare responses of carbofuran with other similar structured compounds using the method developed. All cyclic voltammetric measurements were recorded in a conventional three electrode voltammetry cell with glassy carbon electrode or modified electrode as the working electrode, Ag/AgCl (3.0 mol dm-3)/KCl as the reference electrode and Pt wire as the counter electrode. Voltage scans were done with potentiostat mode (Instrument-MetrohmAutolab PGSTAT 128N), and the current potential curves were recorded through the NOVA 10.0 software. The solutions were de-gassed by nitrogen prior to each electrochemical experiment. In this study, a silafluorene modified glassy carbon electrode was developed for selective detection of carbofuran in aqueous medium. Two independent irreversible oxidation peak potentials were obtained at 0.90 V and 1.45 V vs Ag/AgCl. Cyclic voltammetric studies showed a linear relationship between concentration of carbofuran and its' oxidation peak currents in pH 5 buffer medium with a minimum detection limit of 1100ppm. Structurally similar compounds, such asbenzamide, were also sensitive to this modified electrode, and showed two peaks at potentials different fromthat of carbofuran; 1.22 V and 1.42 V. This comparative study provided evidence about the electrochemical active site of the carbofuran molecule. There is a possibility to undergo an oxidation in –CO-N-H group of carbofuran and benzamide. But there is no –N-H group in carbosulfan and is not sensitive to silafluorene modified electrode. Change in the FTIR spectrum with modified electrode surface suggested that silafluorene could catalyse electrochemical oxidation of carbofuran. Therefore, this modified electrode could be used to measure carbofuran in environmental sources even in millimolar concentrations at a relatively low cost.

Keywords: *Carbofuran, Cyclic voltammetry, Electrochemical, Modified-electrode, Silafluorene*

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[1] *Department of Physical Sciences, Faculty of Applied Sciences, Rajarata University, Mihinthale, Sri Lanka.*

[2] *Department of Physical Sciences, Faculty of Applied Sciences, Rajarata University, Mihinthale, Sri Lanka.*

[3] *Deapartment of Chemistry, Faculty of Science, University of Peradeniya, Sri Lanka.*