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Interaction of glyphosate with platinum electrodes

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Glyphosate [N-(phosphonomethyl)glycine] is a nonselective, post-emergence, broad spectrum herbicide. Its acute oral LD_{50} value reported for rats is 5600 mg/kg. As glyphosate is commonly used, its reactivity toward different chemical species, and development of detection methods would be of important aspects of investigation. The study reported is on investigation of interaction of glyphosate and platinum (Pt) electrodes, and development of an amperometric method for the determination of glyphosate at Pt electrodes.

Cyclic voltammetric experiments of Pt electrodes in 0.1 mol dm^{-3} NaCl with sequential additions of glyphosate indicate the appearance of many new peaks on both reduction and oxidation directions. The peak at -0.15 V vs. saturated calomel reference electrode (SCE) associated with the reduction of surface platinum oxide is initially enhanced, probably due to the high anodic starting potential. However, more sequential additions corresponding to an increase of 7.2 ppm glyphosate concentration per step result in a gradual decrease of this peak with concomitant appearance of a new peak at +0.25 V vs. SCE. Additionally, many new anodic and cathodic peaks are observed on the pure Pt surface, which is formed after the reduction of the surface oxide. These new peaks significantly alter the H-adsorption/desorption regions. The cyclic voltammetric scan, recorded with 140 ppm glyphosate concentration, indicates the appearance of an intense, concentration dependent redox couple centered at about -0.40 V vs. SCE. The log (peak current) vs. log (scan rate) plot for the reduction peak of this couple results in a linear relationship with a slope of about 0.50, suggesting that the mode of transfer of glyphosate molecules toward the electrode surface for electrochemical reaction is diffusion.

Steady-state amperometric experiments conducted at -0.45 V vs. SCE with sequential additions of glyphosate results in linear calibration curves with the sensitivity of 1.50×10^{-1} $\mu A\ mol^{-1}\ dm^3$, linear range (LR) of 14 ppm to 60 ppm, and the minimum detection limit (MDL) of 0.6 ppm.

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