

Simultaneous Detection of Cd⁺², Fe⁺², Co⁺², and Pb⁺² Heavy Metal Ions by Stripping Voltammetry Using Polyvinyl Chloride Modified Glassy Carbon Electrode

Authors : Sai Snehitha Yadavalli, K. Sruthi, Swati Ghosh Acharyya

Abstract : Heavy metal ions are toxic to humans and all living species when exposed in large quantities or for long durations. Though Fe acts as a nutrient, when intake is in large quantities, it becomes toxic. These toxic heavy metal ions, when consumed through water, will cause many disorders and are harmful to all flora and fauna through biomagnification. Specifically, humans are prone to innumerable diseases ranging from skin to gastrointestinal, neurological, etc. In higher quantities, they even cause cancer in humans. Detection of these toxic heavy metal ions in water is thus important. Traditionally, the detection of heavy metal ions in water has been done by techniques like Inductively Coupled Plasma Mass Spectroscopy (ICPMS) and Atomic Absorption Spectroscopy (AAS). Though these methods offer accurate quantitative analysis, they require expensive equipment and cannot be used for on-site measurements. Anodic Stripping Voltammetry is a good alternative as the equipment is affordable, and measurements can be made at the river basins or lakes. In the current study, Square Wave Anodic Stripping Voltammetry (SWASV) was used to detect the heavy metal ions in water. Literature reports various electrodes on which deposition of heavy metal ions was carried out like Bismuth, Polymers, etc. The working electrode used in this study is a polyvinyl chloride (PVC) modified glassy carbon electrode (GCE). Ag/AgCl reference electrode and Platinum counter electrode were used. Biologic Potentiostat SP 300 was used for conducting the experiments. Through this work of simultaneous detection, four heavy metal ions were successfully detected at a time. The influence of modifying GCE with PVC was studied in comparison with unmodified GCE. The simultaneous detection of Cd⁺², Fe⁺², Co⁺², Pb⁺² heavy metal ions was done using PVC modified GCE by drop casting 1 wt.% of PVC dissolved in Tetra Hydro Furan (THF) solvent onto GCE. The concentration of all heavy metal ions was 0.2 mg/L, as shown in the figure. The scan rate was 0.1 V/s. Detection parameters like pH, scan rate, temperature, time of deposition, etc., were optimized. It was clearly understood that PVC helped in increasing the sensitivity and selectivity of detection as the current values are higher for PVC-modified GCE compared to unmodified GCE. The peaks were well defined when PVC-modified GCE was used.

Keywords : cadmium, cobalt, electrochemical sensing, glassy carbon electrodes, heavy metal Ions, Iron, lead, polyvinyl chloride, potentiostat, square wave anodic stripping voltammetry

Conference Title : ICECR 2022 : International Conference on Electroanalytical Chemistry Research

Conference Location : Paris, France

Conference Dates : July 19-20, 2022