Revolutionary Sensor Unveiled: Impedimetric Determination of Ammonium in Water with Cutting-Edge Silver-Poly-Aminoanthraquinone-Carbon Paste Electrode

Mahmoud Fatehy Altahan[1,*], Amr Mohamed Beltagi[2], Magdi Abdel-Azzem[3] and Mona A. El-Attar[4]

Abstract

Here, we present the electrochemical determination of ammonium in water samples, emphasizing the importance of accurate and precise assessment of its concentration. Ammonium plays a crucial role in the nitrogen cycle of natural waters and serves as a vital nutrient for primary production processes. To enable the accurate determination of ammonium, we developed a cutting-edge sensor for impedimetric analysis. The modified electrode used in this study was fabricated through the anodic polymerization of 1-aminoanthraquinone (1-AAQ) and deposition of silver particles into a carbon paste electrode. The fabrication process involved cyclic voltammetry in a 0.1 M HCl solution, followed by the application of a potential of 0.2 V for 75 seconds. The resulting Ag/poly-1-AAQ/CPE exhibited remarkable electrochemical properties, as confirmed by scanning electron spectroscopy, energy-dispersive X-ray analysis, and elemental mapping. The Ag/poly-1-AAQ/CPE was employed for impedimetric determination of ammonium in a solution of 0.1 M Na_2SO_4. The impedance-based detection mechanism offered several advantages, including a rapid response time, high selectivity, and a wide linear range for ammonium quantification. The charge transfer resistance (R_{ct}) output from the application of equivalent circuits to the experimental impedimetric data exhibited good linearity. The determination of ammonium using the Ag/poly-1-AAQ/CPE was performed over a concentration range of 5 µM to 100 µM NH_4^+, with a detection limit of 3.3 µM NH_4^+.