

大會專題演講

Electrochemical Analytical Processes for Water Quality Management

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Abstract

The integrity, dependability, and quality of laboratory data are the most important assets of our analytical chemistry profession. It is imperative that all laboratory related activities and practices uphold the highest professional standards.

All chemical analysis processes follow the same scientific principle. That is, the detection of a specific chemical species in water requires, first, citing the chemical species with specific energy, e.g., light, electricity, or high-energy irradiation to enable response from the chemical species in question to produce a signal that is then observed with a detector. The selection of scientific technique for water quality detection depends on the sensitivity, cost, and miniaturization potential for portability and field application. Electrochemical analytical methods have all the above merits, thereby, having become the most popular technique for environmental applications.

Static potentiometry and dynamic controlled potential voltammetry are most used electrochemical methods for water quality management. First, the general principle of potential-controlled voltammetry will be presented. Depending on the wave form of exciting potential, voltammetry is performed in scan and step mode. The merits of cyclic, differential, and square-wave voltammetry and the associated intrinsic principle will be discussed. Anodic stripping voltammetry for metal ion detection in dilute aqueous solution has proved to be a seminal method for long periods of time.

An example on the detection of perchlorate ion using plastic membrane electrode will be given. This is followed by differential pulse voltammetry for the detection of metformin. The advance in electrode fabrication for the sole purpose of increasing detection sensitivity will be presented by exemplifying several metals, including a chromium (III) oxide modified carbon-paste electrode for detection of zinc(II), cadmium(II), lead(II), copper(II) and silver(I), a bismuth-antimony nanocomposite electrode for the simultaneous detection of zinc(II), cadmium(II) and lead(II), a glass carbon supported tin oxide-reduced graphene electrode for the detection of cadmium(II), lead(II), copper(II) and mercury(II), a bismuth nano powder electrode for the detection of cadmium(II) and lead(II). Results clearly demonstrate the merits of nanosized composite electrode versus conventional bulk electrodes.

A metal ion selective polyvinyl chloride (PVC) electrode, synthesized with conducting polysulfoaminoanthraquinone (PSA) ionosphere exhibits Pb(II) selectivity over monovalent and divalent metal ions with a detection limit of 16 micron-mol per liter and a service time of 5 months. Another metal ion selectivity electrode is a carbon paste coupled with multiwalled carbon nanotube that exhibits 2.5 nano-mol per liter sensitivity. Recent advances in electrode development is demonstrated by micro-channel boron doped diamond (BDD) electrode array on silicon wafer electrode, which is capable of detecting cadmium(II), lead(II), nickel(II) and mercury(II) at the nano-mol per liter levels. Finally, a biosensor, exemplified by screen-printed carbon electrode for glucose sensing will be briefly reported.