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Simultaneous Electrochemical Detection of Multiple Heavy Metal Ions in water

The on-line monitoring capability of heavy metal ions would be of interest to the laboratory water market. Heavy metal ions are a cause of environmental pollution from a number of sources, including lead in petrol, industrial effluents and leaching of metal ions from the soil into lakes and rivers by acid rain. The concept of stripping voltammetry is a well understood and highly respected technique that has been applied for trace level detection of heavy metal ions, such as zinc, lead, cadmium, copper, mercury, arsenic, etc. There are commercially available voltammetric systems available, such as Metrohm, however, they tend to use expensive electrodes such as gold and glassy carbon, and in certain applications, toxic electrodes, such as mercury. Existing approaches also fail to detect multiple heavy metal ions at the same time. In addition to the cost and toxicity issues, the measurements are generally performed in batch mode.

This technology would avoid the use of mercury by using bismuth electrodes, which has the advantages of being environmentally friendly and easier to dispose. It has also been reported to provide equivalent performance when compared to mercury-based electrodes. The disposable screen printed electrodes would include reference and auxiliary electrodes. This screen printed electrode would be integrated into a dedicated flow-through cell and a given electrode could simultaneously monitor several ions with the one sample, for example a bismuth electrode could measure zinc, lead, cadmium and copper from the same sample. The electrochemical route for detecting multiple heavy metal ions simultaneously in water offers distinct advantages of speed, miniaturization and sensitivity, thus addressing the urgent needs for field testing of these species.

Potential Applications

- Laboratory water
- Ultrapure water purification systems
- Water quality monitoring systems

Benefits and Advantages

- Multiple heavy metal ion species can be measured simultaneously
- Less expensive due to the presence of screen printed electrodes with integrated auxiliary and reference electrode
- Detection levels in the ppt range (ng/L)
- On-line measurements

