Amgen Seminar Series in Chemical Engineering

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Nanostructured Electrochemical sensor for Detection of Seawater Nutrients

By

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Nitrite salts are widely used in industrial manufacturing and over fertilization can lead to the contamination of surface water and groundwater. For example, nitrites can cause the transformation of normal hemoglobin to methemoglobin, leading to loss of hemoglobin's ability to transport oxygen and can also lead to accelerated algae growth and eutrophication of large bodies of water. There is an unmet need for portable, reliable and economical sensor for nitrites due to its ubiquitous nature and toxicity. Herein, we demonstrate the use of multi-wall carbon nanotubes screen printed electrodes (MWCNT-SPE) that have the capability for individual determination of nitrite anions at micromolar concentrations in aqueous solutions. Initial studies using cyclic voltammetry (CV) the MWCNT-SPE gave a detection limit of 10 μM for nitrite detection at pH = 3.00 with a linear range from 10μM to 400 μM. Recently, amperometric detection approach with better signal-to-noise (SNR) ration coupled to microfluidic sample delivery system has shown that the same electrodes can detect nitrites at ultra-low micromolar concentrations. Analytical figures of merit were optimized including applied voltage, pH and flow rate to provide the best conditions for nitrite detection. Results gave a detection limit of 0.02 μM nitrite and a wide linear range from 0.02 to 400 μM at mild pH= 4.00 condition and an applied potential of 0.65V versus Ag/AgCl. This represents 500-fold lower DLs that the CV electrochemical strategy. Validation of this electrochemical detection method is currently on going in our lab and will involve collaboration with other researchers involved in C-AIM thrust 3 and other inter thrust research teams. The disposable MWCNT-SPE offers a low cost, portable and economic approach for nitrite detection in seawater samples.

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