Sol–Gel Immobilized Optical Microalgal Biosensor for Monitoring Cd, Cu and Zn Bioavailability in Freshwater

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Abstract

While analytical measurements provide the quantitative estimation of the total amount of metals present in a sample, they do not reflect the truly bioavailable fraction of metal which reflects the adverse biological effect. Hence the development of monitoring tools for detecting bioavailable toxic metals has become a priority in environmental monitoring activities. An optical whole-cell biosensor was constructed using the microalga Scenedesmus subspicatus MM1 immobilizing in inorganic silica hydrogels using the sol-gel technique to detect bioavailable Cadmium (Cd2+), Copper (Cu2+) and Zinc (Zn+) in freshwater. Conditions for optimum biosensor performance have been established regarding effective pH range, cell density, exposure time, and storage stability. The optimum response for the biosensor was dependent on the pH of the matrix, cell concentration and exposure time were derived. The biosensor was operational for four weeks. The limit of detection for the algal biosensor was determined as $9.0 \times 10{-}1$, $9.1 \times 10{-}1$, and $8.8 \times 10{-}1$ mg/L for Cd, Cu and Zn, respectively. Whole-cell cell biosensor will be highly useful since it comprises a single microalgal species able to detect the bioavailable content of Cd2+, Cu2+, and Zn2+ in freshwater.

Citation

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