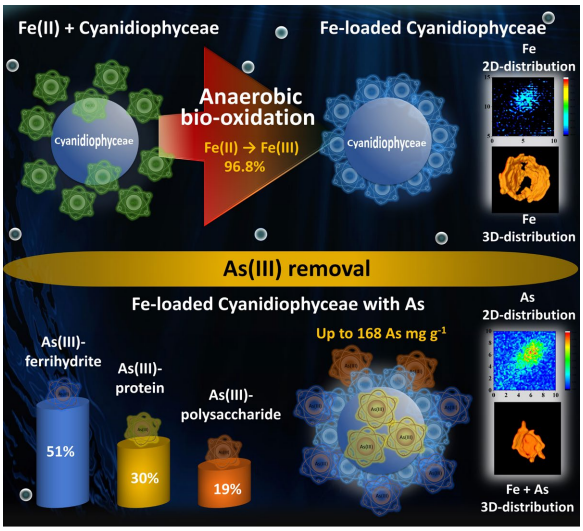
Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31287

Enhanced As(III) Removal via Anaerobic Fe(II) Bio-Oxidation by Cyanidiophyceae: A Novel and Effective Bio-Based Solution for Adaptive As Remediation

YEN-LIN CHO[1], NHU ANH THI THAN[2], LIANG-CHIANG HSU[2], YU-HSIEN CHEN[2] AND YU-TING LIU[2]

[1]National Sun Yat-sen University
[2]National Chung Hsing University



In anaerobic environments, arsenic (As) dissolution is closely linked to iron (Fe) cycling. Under anoxic conditions, ferric iron [Fe(III)] is reduced to ferrous iron [Fe(II)], which mobilizes As into groundwater. This process exacerbates contamination risks, posing a significant environmental challenge. This study investigated the anaerobic Fe(II) bio-oxidation potential of Cyanidiophyceae [*Cyanidium caldarium* (Cc)] to develop Fe(II)-loaded biomaterials for efficient arsenite [As(III)] removal. Cc exhibited a remarkable ability to convert over 97% of Fe(II) to Fe(III), significantly enhancing As(III) sorption capacity (Figure 1). The As(III) sorption on Fe-loaded Cc was 1.4 times higher than that on unmodified cells, reaching 167.8 mg g^{-1}. Synchrotron-based analyses revealed that *Cc* primarily facilitates intracellular detoxification of As(III) by forming As(III)-cysteine complexes, effectively reducing its toxicity. Synchrotron-based techniques, including Transmission X-ray Microscopy (TXM), X-ray Nanoprobe (XRF), X-ray Absorption Spectroscopy (XAS), and Synchrotron-based Fourier Transform Infrared Spectroscopy (SR-FTIR), were employed to investigate the two- and three-dimensional (2D and 3D) algal morphology, Fe and As spatial distribution within algal cells, Fe and As speciation, and protein structural changes. These analyses provided molecular-level insights into the mechanisms driving enhanced As removal by Fe-loaded Cyanidiophyceae. Additionally, Fe(III) hydroxides formed through anaerobic Fe(II) bio-oxidation and subsequent aging further improved As(III) uptake efficiency. These findings highlight the potential of Cc as a sustainable and resilient bioremediation agent, particularly for mitigating As contamination in Fe-rich anaerobic environments.