Enhancing Reductive Dechlorination of Trichloroethylene in Bioelectrochemical Systems with Conductive Materials

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Motivation

The incorporation of conductive materials to enhance electron transfer in bioelectrochemical systems (BES) is considered a promising approach. However, the specific effects and mechanisms of these materials on trichloroethylene (TCE) reductive dechlorination in BES remains are not fully understood. This study investigated the use of magnetite nanoparticles (MNP) and biochars (BC) as coatings on biocathodes for TCE reduction.

Materials & Methods

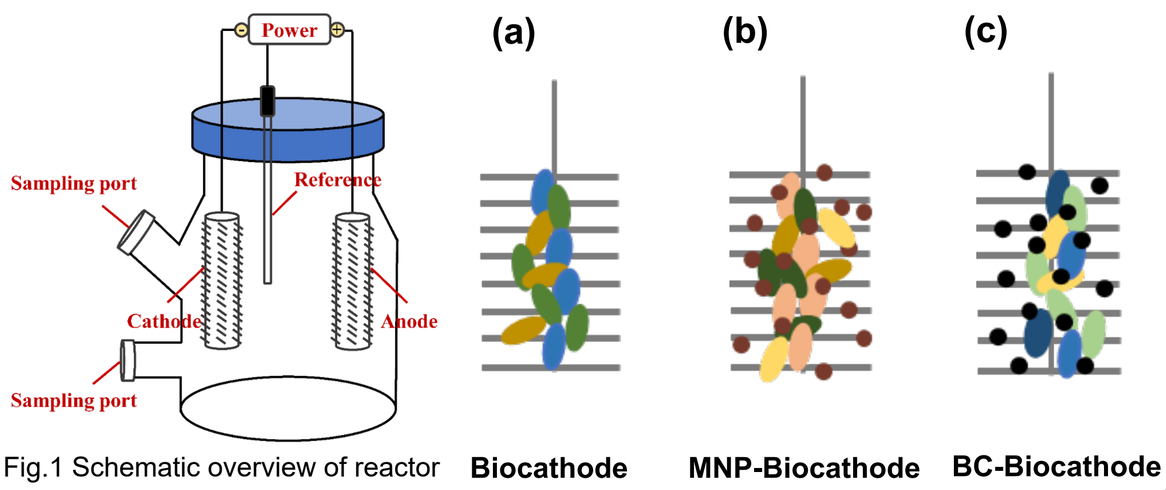

Fig.1 Schematic overview of reactor

Results & Discussion

1.Performance of TCE reduction

In the Period II and III, the average dechlorination rate of MNP-Biocathode and BC-Biocathode were significantly higher ($p < 0.05$) than that of Biocathode, by factors up to 1.63 and 1.37, respectively.

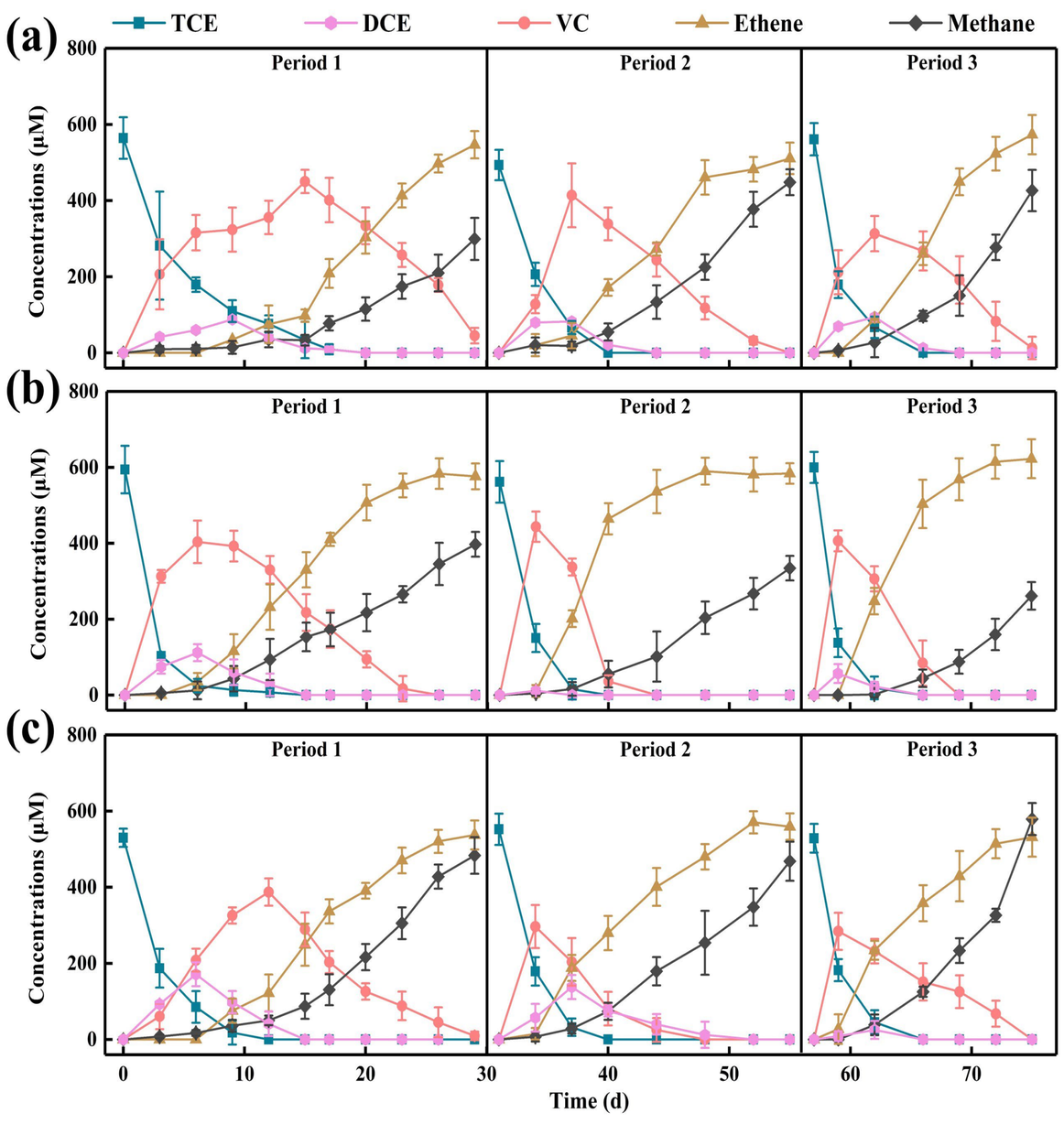

Figure 2. Dechlorination kinetics of Biocathode (a), MNP-Biocathode (b), and BC-Biocathode (c)

The dechlorination rate of MNP-Biocathode and BC-Biocathode increased in all TCE dechlorination steps, with the most significant promotion observed during TCE-DCE step, while the rates of VC-Ethene step remained closely comparable.

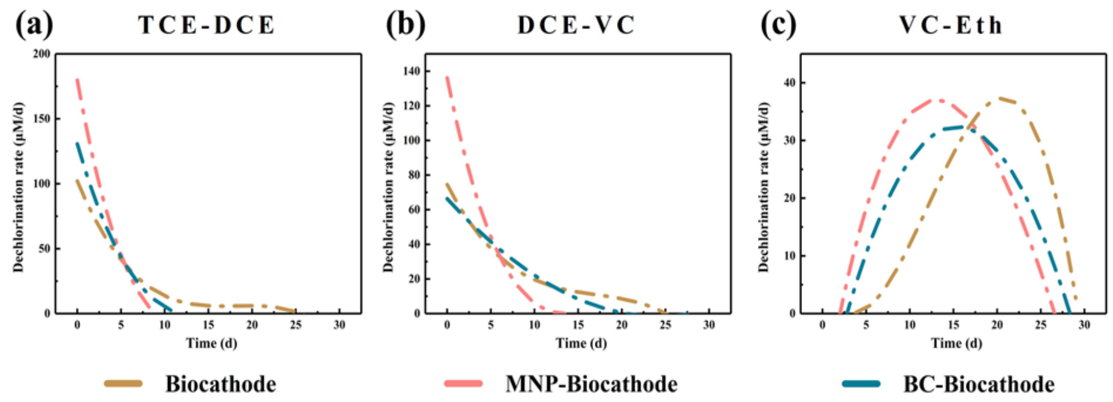

Figure 3. Reduction dechlorination rate of TCE-to-DCE (a), DCE-to-VC (b), and VC-to-Ethene (c) step based on MATLAB fitting

2. Responses of microbial community

Conductive materials promoted the proportion of electroactive and dechlorinating microorganisms (e.g., *Pseudomonas*, *Geobacter*, and *Desulfovibrio*) on the cathode.

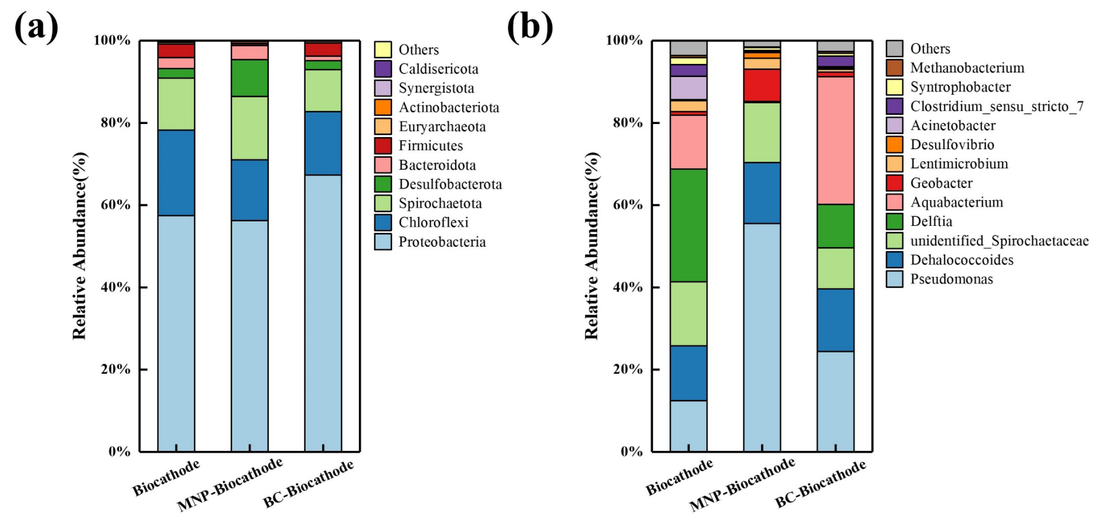

Figure 4. Microbial community compositions at phylum (a) and genus (b) level

3. Expressions of functional genes

The high expression of RDase and DET related genes in MNP-Biocathode and BC-Biocathode was consistent with the superior dechlorination rate.

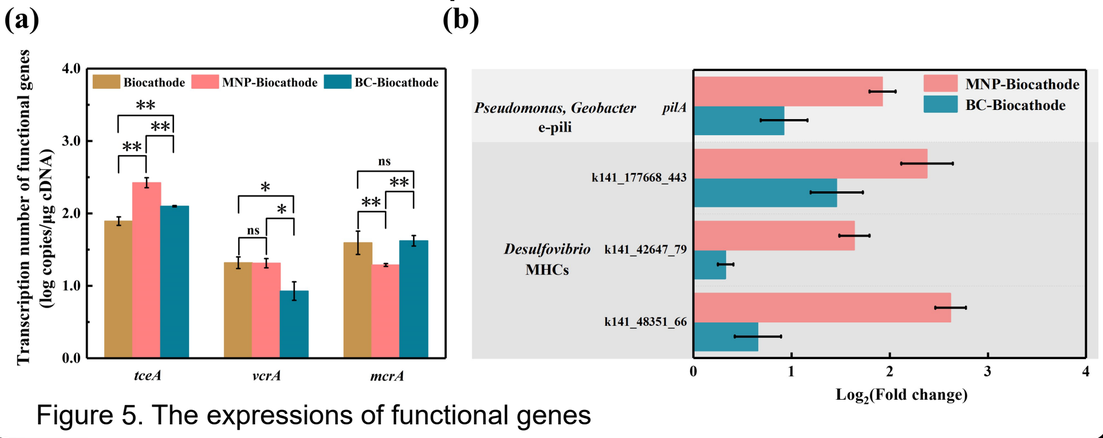

Figure 5. The expressions of functional genes

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