Effect of redoxactive organic compounds on extraceller uranium (VI) reduction by using electrochemical methods

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Reduction of soluble uranium (VI), to insoluble uranium (IV), is an important process for the immobilization of uranium in subsurface environment. Lojou *et al*. (1999) has showed that cytochrome c_3, which is a membrane protein, has catalyzed the reduction from U(VI) to U(IV). On the other hand, Suzuki *et al*. (2010) has reported that flavin mononucleotide, which is a coenzyme, was capable to mediate the reduction of U(VI). This result has showed a potential of extracellular electron shuttle in the microbial U(VI) reduction. However, biogenic organic mediators to be able to reduce U(VI) have not been fully understood. This study aims to clarify the U(VI) reduction catalyzed by several organic mediators other than above two mediators by using electrochemical method. The biological study was also done to examine the U(VI) reduction by microorganisms under anaerobic condition.

Three flavin analogues (flavin mononucleotide (FMN), riboflavin (RF) and flavin adenin dinucleotide(FAD)), quinone and methylviologen were used as a U(VI) mediator. Redox reaction between U(VI) and organic mediator was investigated by using cyclic voltammetry and bulk electrolysis with UV-vis spectroscopy.

The cyclic voltammograms of the organic mediators in the presence of U(VI) showed that reduction current of the mediators increased with the U(VI) concentration, indicating the reoxidation of organic mediators by U(VI). The rate constant of catalysis reaction acceralated by the organic mediators were determined. The rate constants of catalysis reaction, $k_{cat,}$ were almost the same among the flavin analogues (RF:45.9, FMN: 35.9 and FAD 35.9 M^{-1} s^{-1}). The k_{cat} values for the methylviologen and quinone derivative were also determined to be 89.2 and 2.71 M^{-1} s^{-1}. Althogh these values were smaller than the value of cytochrome c_3, 9,000 M^{-1} s^{-1}, our results clearly demonstrated that various kinds of biomoleculse can work as a mediator for the extraceller reduction of U(VI) under anaerobic condtion.