

Changes in Valence State and Spatial Distribution of Iron on Pure-cultivating *Acidothiobacillus ferrooxidans* cells

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Acidothiobacillus ferrooxidans (*A. ferrooxidans*) is widely found in acid mine drainages (AMD) and has been well proven to promote the oxidation of sulfide minerals. In this study, we analyzed the concentration changes of ferrous and ferric ions in the pure culture of *A. ferrooxidans* as long as 21 days. The distribution of ferrous and ferric species on the cell surface was also characterized, therefore, the mechanism for microbial oxidation of Fe^{2+} can be comprehensively disclosed as ferric ions are thought to be the specie driving the sulfur oxidation of sulfides.

A. ferrooxidans in this study was isolated from the AMD in the Dongguashan Cu-Au Mine in Tongling, eastern China. After adding *A. ferrooxidans* into 9K culture with 1.0g/L Fe^{2+} concentration and a final cell concentration of 9.37×10^7 cells/mL, the Fe^{2+} concentration rapidly reduced by about 10%, which is probably attributed to surface adsorption of cells. As to the 5th day, Fe^{2+} concentration decreased to below the detect limit of means of O-phenanthroline spectrophotometry, while Fe^{2+} and Fe^{3+} concentration of the control group without bacteria cells and heated-cell group kept constant.

By employing XANES spectroscopy and STXM, we found there were simultaneous two valence states of Fe on living cells, i.e., more Fe(II) and less Fe(III) species. Many nanoparticles containing Fe and S coating the cell surface were found by using STEM coupled with EDS analysis. However, iron was hardly detected on the cells repeatedly washed by dilute sulfuric acid and on dead cells.

In summary, the active *A. ferrooxidans* can adsorb Fe^{2+} and then oxidize it to Fe^{3+} , which were partly transformed into nanoparticles on cells and the rest was released into the experimental solution. The finding of secondary nanoparticles on cell surface suggests another potential oxidizing kinetics involved by the intermediate mineral phases.

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