Microbial Electron Transfer at Clay-Modified ITO Electrodes

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Shewanella Putrafaciens is a bacterium which can use as a terminal electron acceptor iron. Consequently it has been investigated for use in microbial fuel cells (MFC) in which electrons are diverted to an electrode surface. Electron transfer is accomplished in three possible modes: direct electron transfer (DET) via contact of the cell wall terminal cytochrome c to the electrode surface, DET via contact of a pile containing cyctochrome c to the electrode surface, and via mediated electron transfer via extruded electron carriers.

In order to optimize the output of MFC various methods have been attempted to minimize electrode fouling by dead and dying cells, to minimize the distance between the cells and electrode surface, and to enhance mediated electron transfer. In this study we investigate the role of the electrode surface on the kinetics and thermodynamics of electron transfer. We use an evanescent wave ATR set up which allows us to monitor those cells directly near the surface of the electrode (~100 nm distance). We are able to monitor the attachment of cells to the electrode surface via capacitive current changes and via broadband light scattering. We are also able to monitor the extent of electron transfer via faradaic currents and changes in the optical band of iron in the cytochrome c.

Using this set up we investigate the effect of added mediator and the effect of electrode modification by both naturally occurring negatively charged (nontronite and montmorillonite) and positively charged (layered double hydroxide) clays. Preliminary results will be presented.