

Viable cells biosensors based on chemically modified electrodes

Dr. Enrico Marsili

1. Basis for research

Anaerobic respiratory bacteria generate energy by coupling the flow of electrons in the membrane to the electrochemical proton gradient. The electrons flow from primary electron donors to terminal electron acceptors through intermediate electron transfer agents, such as outer membrane cytochromes and periplasmic proteins. While electron transfer processes are usually intracellular, dissimilatory metal reducing bacteria (DMRB) are capable to reduce insoluble extracellular electron acceptors, such as metals and electrodes. DMRB such as *Shewanella* and *Geobacter* were isolated from several metal-

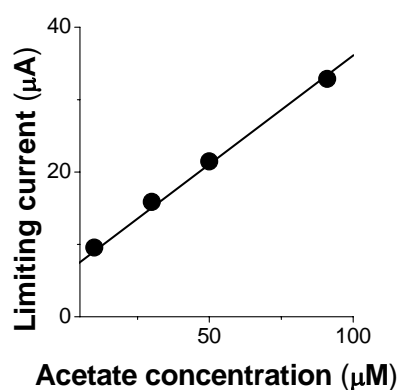


Figure 1: Acetate biofilm sensor

rich environments and are relevant to biogeochemistry and heavy metals bioremediation. They have also been used for electricity production at the anode of microbial fuel cells (MFCs). Because of their unique properties, DMRB were recently termed among the electroactive bacteria (EA bacteria). We recently developed a method to grow EA biofilms in multiple electrochemical cells with potential control, while measuring extracellular electron transfer to the electrodes in a reproducible way. Because of their unique properties, viable EA bacteria may be used in the development of highly sensitive and selective amperometric biosensors for environmental monitoring (i.e., deep sea sediments)

and bioremediation processes control. In fact, we have recently shown that *Geobacter sulfurreducens* biofilms grown on glassy carbon electrodes (GCE) can detect acetate at micromolar concentration in complex organic media (Fig.1).

Viable biofilms-based sensors are particularly interesting for their self-repair capabilities and low cost. However, further research is needed to assess stability, selectivity and durability of such sensors under conditions similar to those encountered in natural environments.

2. Hypothesis under investigation and main aims

Hypothesis: Viable *G. sulfurreducens* biofilms grown on modified GCE may be used to detect with high selectivity and reproducibility acetate in complex organic media.

In this 3-months project, we will:

- modify the GCE surface using established protocols, such as polishing and surface oxidation.
- grow *G. sulfurreducens* biofilms on unmodified and modified GCE;
- use *G. sulfurreducens* biofilms to measure acetate concentration in complex organic media;
- determine sensitivity, selectivity and reproducibility of the proposed biosensor.

4. Methods of research

We will grow *G. sulfurreducens* as formerly described (Marsili et al. (2008). *Appl. Environ. Microb* **74**(23), 7329-7337). We will use cyclic voltammetry and chronoamperometry to characterize the proposed sensor.