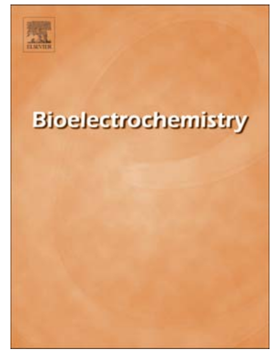
Accepted Manuscript



Electroactive microorganisms and microbial consortia

Enrico Marsili, Stefano Freguia

PII: S1567-5394(17)30606-0
DOI: doi:10.1016/j.bioelechem.2017.12.001
Reference: BIOJEC 7083

To appear in: *Bioelectrochemistry*

Please cite this article as: Enrico Marsili, Stefano Freguia, Electroactive microorganisms and microbial consortia, *Bioelectrochemistry* (2017), doi:10.1016/j.bioelechem.2017.12.001

Electroactive microorganisms and microbial consortia

Enrico Marsili[1,2] and Stefano Freguia[3]

[1]School of Energy Science and Engineering, University of Electronic Science and Technology of China, Chengdu 611731, PR China
[2]Singapore Centre for Environmental Life Sciences Engineering, Nanyang Technological University, 60 Nanyang Drive, 637551, Singapore
[3]Advanced Water Management Centre, The University of Queensland, Brisbane, QLD 4072 Australia

Overview

Research on electroactive microorganisms has been historically focussed on energy recovery from marginal resources (e.g., wastewater) through microbial fuel cells (MFCs) and the bioelectrosynthesis of fuels and fine chemicals. While some research in this area is still ongoing, the scale-up of these processes has proven to be extremely challenging. Therefore, recent research has focused on fundamental interactions between biofilms and electrodes and small-scale applications, such as biosensors. Furthermore, the rapid development of metabolomics and the decreasing cost of full metagenome/metatranscriptome sequencing has stimulated new research on the structure of electroactive communities from wastewater, sediments and less-explored environments. *Bioelectrochemistry* has recently published two special issue on Bioelectrosynthesis: Microbial Electrosynthesis and Bioelectrosynthesis. In this Special Issue, we have included recent research on the microbial ecology of electroactive microorganisms. In the following, we provide a brief summary to help the reader orienting in this exciting research area and to show how microbial ecology can contribute to the real-world applications of electroactive biofilms.

Extracellular electron transfer (EET) mechanisms in single species biofilms

Experiments with single species electroactive biofilms allow the investigation of EET mechanisms in detail. The electroactivity of biofilms is strongly linked to the applied potential of the electrode. Grobbler et al. show how formal electrode potential determines proteomics changes in single species *Shewanella oneidensis* biofilms (Vol. 119, pp. 172-179). Qiao et al. use non-biofilm producing mutants of *Pseudomonas aeruginosa* to conclude that the biofilm serves as a reservoir of microbially produced redox mediator phenazines, thus increasing the overall EET rate (Vol. 117, pp. 34-39). Yates et al. dwell on the EET mechanism of *Geobacter sulfurreducens*, showing that short-distance and long-distance EET mechanisms occur simultaneously under anodic conditions (Vol. 119, pp. 111-118).

EET in syntrophic communities

EET networks are much more complex in mixed microbial biofilms, thus a meta-omics approach is often used. Semenec et al. reports the proteomics of a syntrophic co-culture electroactive consortia, highlighting a transition from cytochrome-driven to hydrogen-driven interspecies electron transfer (Vol. 119, pp. 150-160). In complex microbial communities, EET is dependent on the temperature, as it causes a shift in microbial community composition, thus changing the overall power output. Xing et al. report the effect of decreasing temperature on the whole electroactive community (Vol. 117, pp. 29-33), while Yilmazel et al. isolated and characterized two novel iron-reducing archaea strains, *Geoglobus angahari* and *Ferroglobus placidus*, capable of high EET in MEC at high temperature (Vol.