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Session 8
EXPLOITATION OF MICROBES FROM NON-CONVENTIONAL (ARID ENVIRONMENTS, DEEP SEA, ETC) AND CONTAMINATED HABITATS

Sub-session 8.1.
Microbial community management in biotechnological processes, aquifer natural attenuation, and in cultural heritage protection/restoration

Main lecture

LINKING MICROBIAL METABOLISM TO ELECTRODES: A STRATEGY TO IMPROVE THE EFFICIENCY OF BIOREMEDIATION AND BIOPRODUCTION SYSTEMS

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Abstract

Only a few years ago, the capability to engage in extracellular electron transfer (EET) with insoluble substrates was regarded as a peculiarity of microorganisms thriving on insoluble electron acceptors, such as dissimilatory iron- or manganese-reducing bacteria. Nowadays, a wide and ever-increasing number of so called "electro-active" bacteria and mixed cultures, capable of using solid-state electrodes as either electron acceptors or donors in their metabolism have been described, suggesting that this trait is probably more widespread in nature than previously thought.

Although many fundamental aspects of EET still remain largely unknown (particularly those involved in electron transfer *from* electrodes *to* bacteria, as occurs in microbial biocathodes), a variety of microbial electrochemical technologies (MET), targeting bioenergy or biochemical generation, wastewater treatment, or subsurface bioremediation have recently been described. Key to all of them is the possibility to effectively link microbial metabolisms to electrodes in order to gain a direct electrochemical control over bioprocess performance.

Specifically, in the field of in situ bioremediation, where issues like the real-time control of microbial activity and degradation efficiency are of pivotal importance, MET hold a remarkable potential for application. Similarly, the possibility of using MET to produce chemicals or clean fuels from waste organics or even from water, carbon dioxide and renewable energy is also attracting considerable attention worldwide.

Here, the results of our most recent investigations on the development and characterization of microbial biocathodes for trichloroethene bioremediation and for gaseous biofuels (H_2 or CH_4) production are presented and discussed. Main attention is also paid to the involved biocathodic electron transfer mechanisms and on how they can affect bioprocess performance and steer the composition of the involved microbial communities.