Master thesis

Design and implementation of a microbial fuel cell for purification and power generation from pond water

Electroactive microorganisms have the unique ability to exchange electrons with electrodes. The underlying process is called extracellular electron transfer (EET). By means of EET, the microbial metabolism can be coupled with the flow of electric current. Therefore, electroactive microorganisms have great potential for applications in microbial electrochemical technologies. For example, they can be used in microbial fuel cells (MFC) to degrade organic material in wastewater and other waters, transferring electrons to electrodes to provide electrical energy. With the help of EET, electroactive microorganisms influence e.g. the carbon cycle and can be found in numerous microbial communities (e.g. in the human gut microbiome).

Water and wastewater treatment is an energy-intensive (3 % of annual energy production) and cost-intensive process. In contrast, MFC is an energy-producing and cost-effective alternative for the purification of wastewater and other bodies of water that has been continuously scaled up in recent decades. Nevertheless, a successful application is still hampered by high investment costs for electrodes.

Within the scope of this M.Sc. thesis, up to 5 large-scale MFC are to be built, consisting of a dense packing of graphite granules, which are produced at low cost, have good electrochemical properties and high biocompatibility. The MFC will have a size of approx. 1×0.5×0.2 m and can be interconnected electronically to increase the current yield. They will also be equipped with floats so that they can float on the pond on the UFZ site. Once the MFC have been installed, electricity production will be continuously monitored, power curves will be drawn up regularly and the microbial community will be analyzed.

In addition to electrochemical methods and anaerobic cultivation techniques, analytical (HPLC, COD analysis) and molecular biological (PCR, T-RFLP) methods will also be used. The work will be carried out with modern laboratory equipment in an international and multidisciplinary team and excellent supervision in accordance with the supervision guidelines of the Helmholtz Association and the UFZ is guaranteed throughout the preparation of the Master's thesis.

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