Capacitive bio-anodes for electricity production in Microbial Fuel Cells

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Motivation

Adaptation and adoption to green technologies is necessary to create a sustainable future. The Microbial Fuel Cell (MFC) is such a new technology which gained large momentum the last decade for renewable energy production. The technology is based on active microorganism which converts organic waste streams into electricity. At the same time, clean water is produced.

State of the art technology is the fluidized bed MFC (figure 1). It consists of an anodic charging column and discharging cell, which uses a membrane. The bacteria grow on the fluidized activated carbon granules while converting organic compounds of the wastewater into electrons, protons and carbon dioxide. The electrons are stored as charge inside the porous granule. Electro-neutrality is obtained by a electric double layer of cations on the pore surface of the granule. Electrons and cations are released in the discharging cell by bouncing against the current collector. Electricity can be generated via an external circuit to the cathode while the cations pass the membrane to react with an electron acceptor and the electrons to produce clean water.

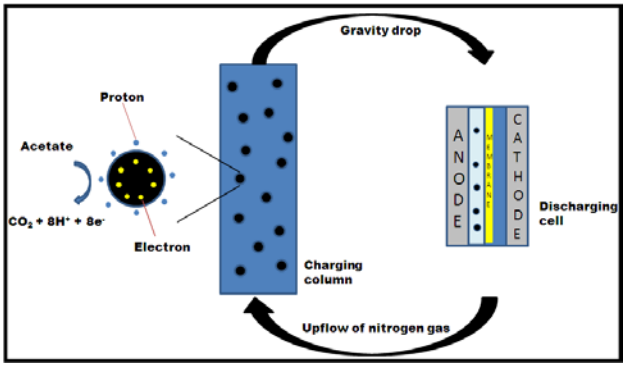

Figure 1. Schematic overview of fluidized MFC

Technological challenge

Several questions remain to be answered before a capacitive bioanode MFC can be brought to application. Therefore the efficiency of the Microbial Fuel Cell could be improved by:

- *Optimizing operational parameters*

Low substrate concentrations through high conversion rates are favorable for direct current production. Parameters that need to be investigated to achieve this goal are: particle and organic loading rate, discharge potential and charge / discharge time.

- *Optimizing architectural design*

The efficiency of a MFC can be improved by optimization of architectural design. Main considerations for reactor design are sufficient contact between influent and bacteria (granule), optimization of granule transport and optimization of electrical contact between granules and anode in the discharge cell with operationalization of discharge time.

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