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Extracellular Polymeric Substances secreted by *Geobacter sulfurreducens* under electroactive conditions.

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1 Motivation

- Bioelectrochemical Systems (**BES**) use bacteria as catalysts for the production of current and/or organic products
- Electroactive bacteria usually form Biofilms on electrodes of Microbial Fuel Cells (**MFC**)
- Biofilms consist of water, cells and **Extracellular Polymeric Substances (EPS)**
- EPS of electroactive bacteria have been rarely studied

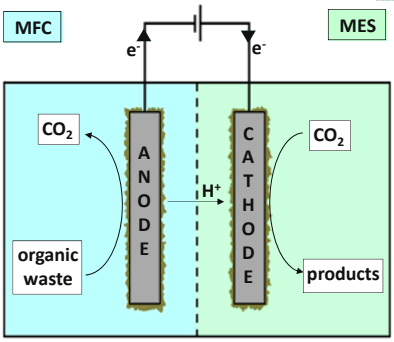

Fig. 1: Schematic of a Bioelectrochemical System (BES) composed of a Microbial Fuel Cell (MFC) at the anode and a Microbial Electrosynthesis (MES) at the cathode.

2 Experimental

- The electroactive bacterium *G. sulfurreducens* was grown in a H-cell MFC unsing anode respiration (conditions given in Fig. 2)
- Biofilms were harvested for fractionation and analysis as presented in Fig. 3

Fig. 3: Sequence of images illustrating the mechanical biofilm harvest from an anode.

3 Experimental

G. sulfurreducens cultivation and EPS extraction and fractionation scheme

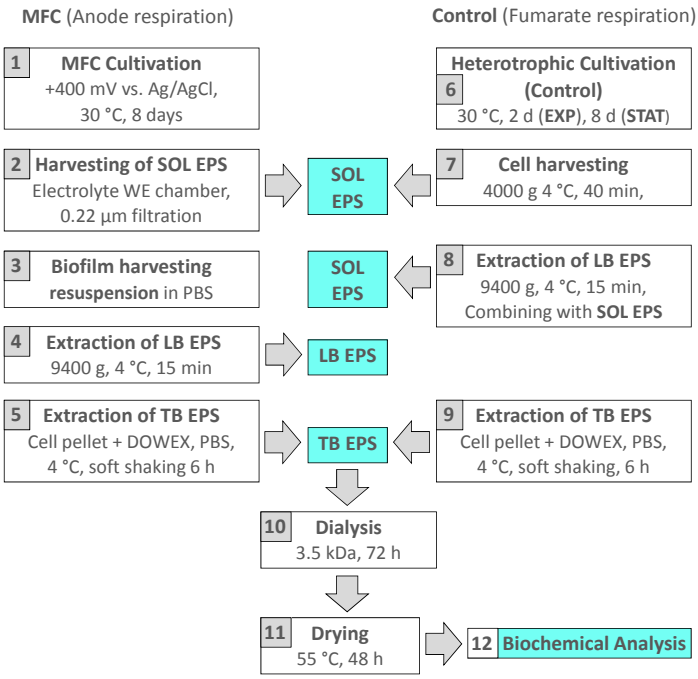

Fig. 2: Schematic route of the biofilm harvest and EPS fractionation of *G. sulfurreducens* for MFC grown anode respiring cells (left) and heterotrophically grown fumarate respiring cells. Fractionation in soluble (SOL EPS), loosley bound (LB EPS) and tightly bound EPS (TB EPS).

4 Results

- *G. sulfurreducens* gave a current density curve typical for MFCs with a maximum current density of 170 µA cm^{-2} after 7 days.
- Biochemical EPS anaysis:
  - The highest amount of EPS were produced by *G. sulfurreducens* under **MFC** conditions compared to the control
  - The majority of EPS were detected in the soluble fraction of the EPS
  - Proteins dominate all analyzed EPS fractions
  - Electroactive cells secrete significantly more EPS than the controls

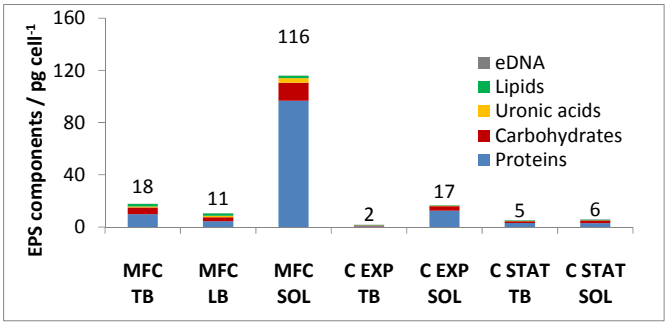

Fig. 4: Composition of EPS secreted by *G. sulfurreducens* under anode respiration in MFCs and under standard heterotrophic conditions as controls. Controls were analyzed after 2 days in exponential phase (C EXP) and after 8 days in stationary phase (C STAT).

5 Results

- Fluorescence images underline the successful of harvest of the biofilms
- The partial harvest of the electroactive biofilm illustrates:
  - a dense electrode coverage with cells on the left side of each images
  - A cell and EPS free electrode after biofilm removal (Fig. 3) on the right

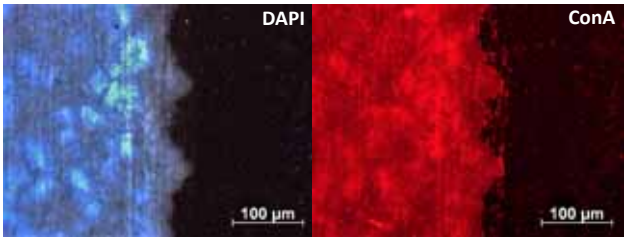

Fig. 5: Fluorescense images (DAPI and ConA) of a partially harvested biofilm on an electrode surface. DAPI signal = cells. ConA signal = EPS.

6 Conclusions

- *G. sulfurreducens* was sucessfully cultivated in a MFC
- Electroactive biofilms were harvested for biochemical analysis
- Harvesting and fractionation allow biochemical analysis of the EPS:
  - *G. sulfurreducens* excretes more EPS under anode respiration compared to cells grown with fumarate respiration
  - Proteins dominate excreted extracellular polymeric substances