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ELECTROTROPHIC MICROBIAL COMMUNITIES DRIVING CATHODIC BIOELECTROCHEMICAL NITROGEN AND CARBON FIXATION

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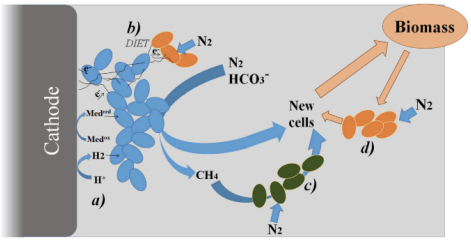
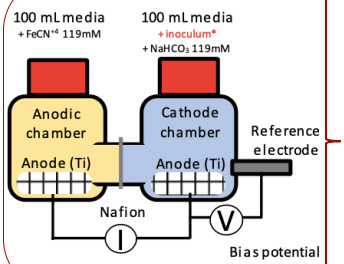
Nitrogen is an essential and limiting nutrient that before the invention of the Haber-Bosh process, was only obtained by biological nitrogen fixation (i.e., BNF). The electrotrophic production of bacterial biomass represents a challenging opportunity with several industrial applications in terms of organic carbon storage and the improvement of soil fertility.



The aim of this study is to evaluate the production of biomass electrotrophically driven solely from N_2 and CO_2 fixation and to characterize the microbial populations involved in this process.

EXPERIMENTAL SET UP



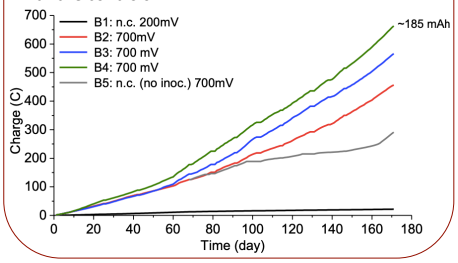
An environmental microbial consortium was inoculated into different bioelectrochemical systems (BES) set up as follows:

- Constant cathodic potential -0.7 V + inoculum
- Constant cathodic potential -0.2 V + inoculum
- Constant cathodic potential -0.7V - inoculum
- Open circuit + inoculum

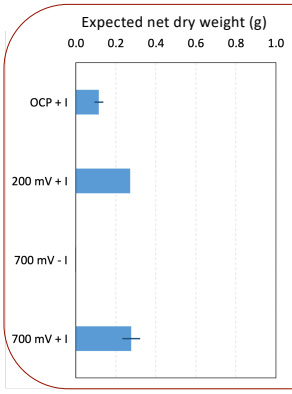
Labelled N and C were provided to the system. After an initial period of stabilization, the BES were run for 165 days.

CHARGE ACCUMULATION

A higher charge consumption was observed in the inoculated systems at -0.7V polarization compared with the controls.

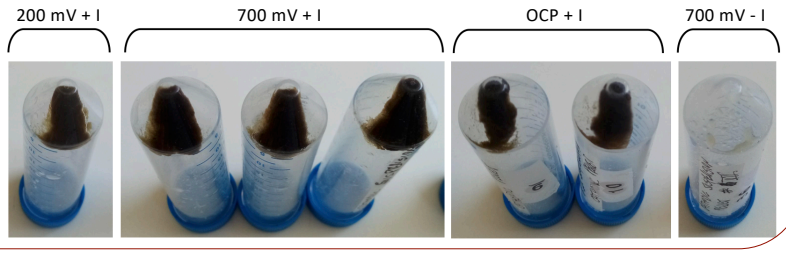


BIOMASS PRODUCTION

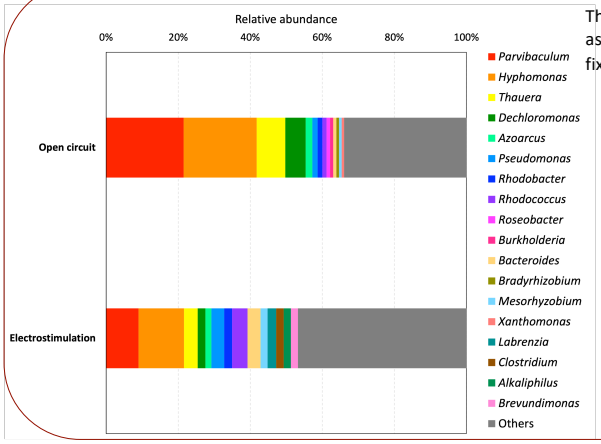


At the end of incubation, polarized inoculated systems produced a higher biomass in the cathodic chamber compared with OC.

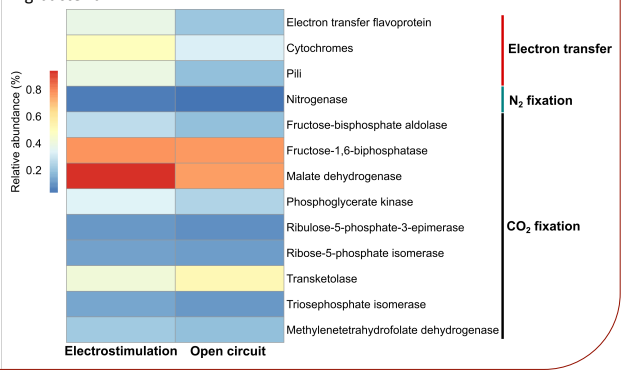
The analysis of labelled N and C and the calculation of the actual biomass increase are ongoing.



ILLUMINA SHOTGUN SEQUENCING OF THE CATHODIC MICROBIAL COMMUNITIES



The electrostimulation increased the abundance of electroactive genera as well as of genes encoding proteins involved in autotrophic and N_2-fixing bacteria.



CONCLUSIONS AND PERSPECTIVES

The findings here presented offer new insights on the ecological and physiological mechanisms involved in the establishment of microbial consortia in oligotrophic environments and pave the way for novel biotechnological applications.

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