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Microbial Electrosynthesis: Electrifying Microbes for Chemical Production from Greenhouse Gas

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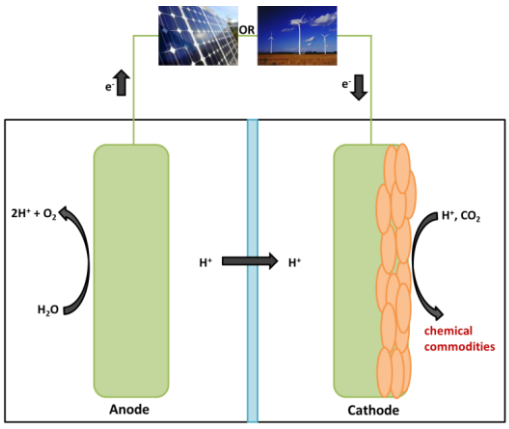
Electrifying microbes to produce valuable chemicals is a new concept that has recently gained traction as one of the potential alternative to our petroleum-based economy. Microbial electrosynthesis (MES) is a bioproduction process in which microbes use electrical current as the energy source to reduce CO_2 to chemical commodities such as biofuels. MES has the flexibility to be coupled with solar or wind energy taking advantage of the electricity surpluses often generated from renewable sources to reduce greenhouse gas emissions in the atmosphere. MES can also be integrated in wastewater treatment by using electricity generated by anodic reactions. Thus, MES has a great potential for the storage of electrical energy coming from renewable sources or from waste into the covalent chemical bonds of commercially viable products. MES applications could result in cutting-edge opportunities for the development of biosustainable technologies in regions like Europe where the biomass availability is less abundant. Although MES has been studied more intensively during the last five years, advances related to the engineering and the biology of this process are required for pilot plant scale and commercialization. Currently, inefficient microbial catalysts with limited CO_2 reduction rates and low electron transfer rates from the electrochemical hardware to the microbial catalysts partially due to the poor adherence of microorganisms on the electrode are some of the main obstacles to commercialization. Gaining information about the metabolism of the microbial catalysts and the electron transfer routes from the electrode to the microbe is critical to establish a rational approach to maximize MES performance. Adaptive laboratory evolution, OMICS approaches, development of genetic systems for electroautotrophs, development of superior biocompatible electrode materials, and investigation of the microbe interactions with these new materials are parts of the strategy that we are implementing to understand MES better and make it more efficient as well as economically feasible.



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