Master Internship proposal (Academic Year 2020-2021)

"Electrochemical study of a halophilic laccase for application in biofuel cells"

Host laboratory: Bioenergetics and Protein Engineering (BIP), Aix-Marseille University - CNRS

Location: Marseille, France

Group: Bioelectrochemistry, biointerfaces and biotechnology (BIP8)

Start date: January-March 2021 (5-6 months)

Supervisor: Ievgen Mazurenko

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Description:

In the industrial ("white") and environmental ("grey") biotechnologies the use of bio-components is often considered as sustainable and cheaper way to produce energy, certain fuels and industrial products, or to fight against environmental pollution. Microbial (fuel) cells (MFC) are typically low-power but robust, durable and versatile energy-producing devices able to utilize different kinds of fuel and concomitantly perform other tasks such as bioremediation or desalination. Bacteria, especially belonging to electrogenic species, are perfectly suited for the anode of MFC thanks to their "omnivorous" nature and identified mechanisms of electron transfer to electrode. However, they are less suited for the cathode, where O_2 usually acts as a unique electron acceptor, since the underlying mechanisms are unknown and both voltage and current densities are low. Therefore enzymes are sought as cathode biocatalysts, e.g. copper-containing laccases (Lac) are known for their ability to oxidize the large variety of phenolic substrates with concomitant 4-electron O_2 reduction at high potential. They are already envisioned for industrial applications such as textile-dye bleaching, lignin degradation and bioremediation. Currently, few reports exist concerning the use of Lac on the cathodes of MFC, notably because of the complex media often containing Lac inhibitors, the most pertinent being chlorides. Some organisms, called halophiles, have adapted to live in salt lakes. We have recently identified and purified a new laccase from such organism which demonstrates promising chloride tolerance thus being a potential candidate for MFC cathode catalyst.

The internship project proposes purification and chloride inhibition investigation, electrochemistry being the main tool, of the new laccase in view of various biotechnological applications. The electrostatic interactions of the enzyme with carbon nanomaterials (nanotubes) in the different ionic strength conditions will be studied to deduce the best immobilization matrix. The final biocathode assembly will be investigated in the media close to that used in MFC.

How to apply:

Please send your CV, motivation letter and marks.