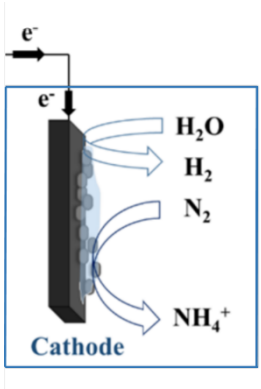
PhD proposal at the University of de Bretagne Occidentale

Hybrid biocathodes fixing Dinitrogen by the Direct Valorization of Dihydrogen

Context

Ammonia is a key industrial raw material for fertilizers, chemicals and energy. The annual artificial ammonia synthesis via the Haber-Bosch process results in about 1% of global energy consumption and can lead to 2% CO_2 emission. Hence, it is urgent to develop environmentally friendly approaches for ammonia synthesis under ambient conditions. With this in mind, the collaborative ANR project CATHOMIX propose to developed mixed biofilms for the electrochemical reduction of dinitrogen (N_2) to ammonia.

PhD project



The aim of the PhD project is to develop hybrid biocathodes (HBI) for the electrocatalytic activation of dinitrogen. These HBI consist of an inorganic catalyst for the reduction of water to dihydrogen (H_2), which can then be used as a reducing agent by a microbial biofilm for efficient electrochemical nitrogen fixation. The thesis work will initially focus on the realization and characterization of efficient cathodes for H_2 production. As carbon is the most used electrode material for the cultivation of biofilms, it will therefore be used for the elaboration of these cathodes. Different approaches to immobilize inorganic or biomimetic electrocatalysts on carbon electrodes will be investigated. The cathodes (HBI) for N_2 fixation will then be manufactured through the colonization of the cathodes by a biofilm. Special attention will be paid to the biocompatibility of the electrodes with biofilms. To characterize the structure and performance of the cathode before and after biofilm development, we will use electrochemical methods such as voltammetry and electrolysis coupled with other in-situ characterization methods such as UV-visible and IR spectroscopy and quartz microbalance.

Working environment

This collaborative research project is financed by ANR and involves three laboratories: INRAE (Narbonne), ISC (Rennes) and CEMCA (Brest). The doctoral student will develop his/her work mainly in Brest, but will also be required to carry out occasional missions within the other partner laboratories.

Candidate profile (skills)

This project is at the interface of inorganic chemistry, materials science and biology. We are seeking for a motivated candidate with MSc degree or equivalent in chemical, physical or biological sciences (chemistry, biochemistry, physical chemistry, analytical chemistry, and chemical engineering). Knowledge in inorganic synthesis, electrochemistry, surface modification or biofilms would be highly appreciated. - No French level required if good proficiency in English (B1): Possibility to work/write the dissertation in both.

To apply please submit the following in one pdf file:

- a covering letter
- a detailed CV,
- an academic transcript (Bachelor + Master 1 and first semester Master 2)
- contact information of at least two references (name+e-mail+phone number)

Bibliography

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Contacts

Frédérique Gloaguen (fgloague@univ-brest.fr)

Noémie Lalaoui (noemie.lalaoui@univ-brest.fr)