



**PhD** : Desired start September 1, 2017 (3-year ANR funding)

**Topic** : Activity and structure of enzymes immobilized on electrodes followed by electrochemical-PMIRRAS coupling: towards the optimization of a biofuel cell.

Hydrogenases are very efficient biocatalysts for the production of energy. A key point, in order to optimize their use, is to perfectly control their orientation on the electrode in order to maximize electron transfer and their enzyme efficiency in terms of turnover. Several aspects have to be optimized in order to obtain an efficient and long lasting biofuel cell, such as protein production, immobilization and electron transfer processes. This research project (ENZYMOR) was funded by the ANR and implicates a consortium of 3 laboratories: the BIP in Marseille, the LBT at the IBCP in Paris and the CBMN in Pessac.

The contribution of the CBMN lab will be the development of a new optical device allowing the coupling of electrochemistry and Infrared spectroscopy (Polarization Modulated Infrared Reflection Absorption Spectroscopy). This new technology will allow to evaluate the structure and the orientation of the adsorbed hydrogenase on the various functionalized electrodes and their electrochemical activity. Currently, the measurements are made separately by electrochemical measurements in bulk samples and by PMIRRAS spectroscopy on dried substrates [1-2]. This novel technology will allow monitoring simultaneous structure / orientation and electrochemical activity during cycling, which is important to optimize the immobilization conditions of the enzyme and thus increase the performance of the biofuel cell.

The PhD student will be in charge of the development of the electrochemistry-PMIRRAS coupling and the evaluation of the responses of different immobilized enzymes for different functionalized electrodes.

[1] A. Ciaccafava, P. Infossi, A. Ronda, S. Lecomte, M.T. Giudici-Ortoni, E. Lojou, *Electrochemistry, AFM and PMIRRAS of Immobilized Hydrogenase*, **Angew. Chem. Int. Ed.** 51, 953-956 (2012).

[2] C. Gutierrez-Sanchez, A. Ciaccafava, P.Y. Blanchard, K. Mosalve, M.T. Giudici-Ortoni, S. Lecomte, E. Lojou, *Efficiency of enzymatic O<sub>2</sub> reduction by Myrothecium verrucaria bilirubin oxidase probed by Plasmon Resonance, PMIRRAS and Electrochemistry*. **Catalysis**. 6, 5482-5492 (2016).

**Candidate's profil**: The candidate must have background in optical spectroscopy and the instrument development. Knowledge in electrochemistry would be appreciated.

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