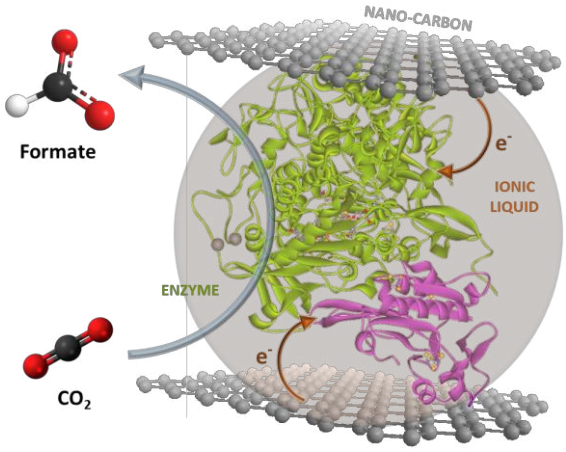
PhD thesis offer (36 months contract) - M/F

Carbon-based ionic electrodes for the electro-enzymatic conversion of CO_2 to formate

*Applications possible until 30 June 2023 (**here**)*

Formate dehydrogenases (FoDHs) are able to selectively reduce CO_2 into formate. To do so, FoDHs require the loosely bound cofactor nicotinamide adenine dinucleotide (NAD) in its active reduced form, 1,4-NADH. We already demonstrated the ability of FoDHs to work in a tandem reaction together with a phosphite dehydrogenase mutant from *Pseudomonas stutzeri* (PtDH), in charge of the clean *in situ* regeneration of 1,4-NADH. Recently, we used the FoDH from *Methylobacterium extorquens* AM1 (*Me*FoDH1), which demonstrates superior CO_2 reducing properties and excellent stability under aerobic conditions [*Green Chem. 22*, **2020**, 3727]. However, NAD is relatively expensive and unstable in the presence of CO_2, making this bi-enzymatic setup unstable over time.



In this project, an elegant alternative to NAD would be to promote the direct electron transfer (DET) between *Me*FoDH1 and the surface of an electrode. The molecular functionalization of innovative nanocarbon electrodes will be performed in order to promote the electrical wiring *via* DET. In particular, original ionic liquids [*J. Colloid. Interface Sci. 636*, **2023**, 668] and nanocarbon-based hybrid ionogels [*Nanoscale 13*, **2021**, 2750] will be developed and employed as supports for *Me*FoDH1.

The work will be carried out in the brand new Balard building (CNRS site) in Montpellier, within the framework of the ANR project CO_2FFEE. The trainee will be surrounded by a dynamic and multidisciplinary **team of 5-10 people** working on enzymatic catalysis, electrocatalysis, ionic liquids and materials science in the D3-MPH department (Porous & Hybrid Materials). The study will be conducted in close collaboration with the team of Dr Damien Voiry (IEMM, Montpellier, France) and Dr Keisei Sowa (Kyoto University, Japan).

The PhD student will be responsible for:

Synthesis and **characterization** (FTIR, liquid NMR) of original ionic liquids

Monitoring of **catalytic reactions** with free and immobilized enzymes using HPLC and/or UV-vis spectroscopy

Nanoconfinement / immobilization of enzymes into nanocarbon-based supports (e.g., buckypapers)

Assessment of bio-**electrochemical properties** using cyclic voltammetry

Exploitation of the data, comparison with existing literature, **drafting** of monthly reports, **presentation** of results in weekly meetings, **communication** at national and international conferences, temporary stays abroad (possible)

Profile	**Master's degree** or **Engineering school (M/F)** with a background in **chemistry** and an interest in **nanomaterials**, **biochemistry** and **electrochemistry** Interdisciplinary topic: excellent **openness** and **curiosity** Required qualities: **motivation**, autonomy, **rigour**, teamwork
Contract duration *Fundings*	**36 months** from **September 2023** (or October the 1st, last date) ANR PRC (projet CO_2FFEE) & Région Occitanie Circulades (projet BIOGAZOVERT) **Monthly grant**: *ca.* ***1 700 €***
Host laboratory *Contacts*	ICGM - Département MPH (D3), Campus CNRS, 1919, route de Mende, Montpellier (FRANCE) **Dr Nicolas Brun**, CNRS associate Researcher – nicolas.brun@enscm.fr – more info ***here*** **Dr Jullien Drone**, associate Professor ENSCM – jullien.drone@enscm.fr
Applications	Only applications submitted before 30 June 2023 will be considered (apply ***here***) Attach a detailed **CV**, a recent letter of **recommendation** and a **cover letter**

CHEMISTRY: MOLECULES TO MATERIALS