MASTER DE CHIMIE DE PARIS CENTRE - M2S2
Internship Proposal 2023-2024

Parcours type(s) / *Specialty(ies) :*

☐ Chimie Analytique, Physique et Théorique / *Analytical, Physical and Theoretical Chemistry* :
☐ Chimie Moléculaire / *Molecular Chemistry* :
☒ Chimie et Sciences Du Vivant / *Chemistry and Life Sciences* :
☒Chimie des Matériaux / *Materials Chemistry:*
☒Ingénierie Chimique / *Chemical Engineering:*

Laboratoire d'accueil / *Host Institution*
Intitulés / *Name* : Laboratoire de Réactivité de Surface (LRS)
Adresse / *Address* : Sorbonne Université, 4 place Jussieu, 75005 Paris
Directeur / *Director (legal representative) :* Pr Hélène Pernot
Tél / *Tel* : 01.44.27.25.77
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Equipe d'accueil / *Hosting Team :* Laboratoire de Réactivité de Surface (LRS)
Adresse / *Address :* LRS – Sorbonne Université, 4 place Jussieu, 75005 Paris
Responsable équipe / *Team leader* : Pr Hélène Pernot (LRS)
Site Web / *Web site :* http://www.lrs.upmc.fr/fr/index.html
Responsable du stage (encadrant) / *Direct Supervisor :* Pr Claude Jolivalt, Dr Julien Reboul
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Période de stage / *Internship period* * : 5-6 months starting from 1 February 2024

Immobilisation of ω-transaminases on Metal Organic Frameworks (MOF) and study of their enzymatic activity after immobilisation

1. *Description of the project.*

Amines are essential building blocks for the synthesis of fine chemicals, agrochemicals, pharmaceuticals and dyes. A sustainable and selective alternative to the chemical reductive amination classically employed in industry to produce amines from ketones or aldehydes is the use of biocatalysts. Enzymes indeed operate at ambient temperature, which saves energy and minimizes the use of toxic metal catalysts and organic solvents. Specifically, the development of transaminases has proven to be efficient for the synthesis of chiral amines, many of which being crucial for the pharmaceutical industry. ω-amino acid aminotransferases (ω-TA) show broad substrate specificity and allow the synthesis of enantiopure chiral amines by asymmetric amination of prochiral ketones, facilitating their implementation as industrial application.[1] However, ω-TA catalyzed reactions are relatively new processes and the cost for production and/or purchase of this type of enzyme is high. Considering the advantages that the use of immobilised bio-catalysts offers, compared to soluble formulations, easy recovery and reuse, improved stability and the possibility for continuous operation

* min. 5 mois maximum 6 mois à partir du 29 janv 2024 / *min. 5 months and max. 6 months not earlier than January, 29th 2024.*
Fin des conventions de stage au plus tard le 12/07/2024 ou le 17/09/2024 et le 15 novembre. *End of internship at the latest July 12, 2024 or September. 17, 2024 and 15 November, 2024.*

in packed bed reactors, to name a few, immobilizing ω-TA on solid support is nowaday a critical issue. Metal-Organic Frameworks (MOFs) were recently shown to be particularly promising as supports to efficiently stabilize enzymes.[2] In our lab, preliminary works showed the positive effect of functionalizing the surface of Zeolite-Imidazolate Frameworks-type MOFs (ZIF) upon the activity of ω-TA.
Based on these exciting preliminary data, and to better understand them, **the mission of the student will be to study the effect of several parameters upon the activity of the ZIF-immobilized ω-TA (i.e. the nature of the chemical functions on the ZIF crystal surface and their density, the type of the immobilization strategy) and to investigate the nature of the enzyme/surface interactions.**

2. *Specific techniques and methods.*

ZIF-supports as well as the enzyme/ZIF interactions will be characterized by several physico-chemical technics available at LRS: Infrared and Raman spectroscopy, powder X-ray diffraction, N_2 volumetric gas adsorption, electron microscopy and X-ray photoelectron spectrometry. The student will be trained and autonomous on most of the measurement apparatus and associated softwares. Immobilized enzyme activity will be spectrophotometrically assessed by established protocoles, already set and running in our laboratory.

The work will be carried out at the Laboratoire de Réactivité de Surface (LRS), located in Sorbonne University, a research group expert in the field of heterogeneous catalysis and MOF.

Profile of the candidate **:** Master's degree student with a background in chemistry and a strong interest for material chemistry (including physico-chemical characterization of porous materials) and biocatalysis. Excellent openness and curiosity, as well as motivation, autonomy and rigour are required.

Application **:** applications must be submitted before 10th December 2023 (see contacts above). A detailled CV and a short cover letter must be attached.

3. *References*

[1] A. Gomm and E. O'Reilly, Transaminases for chiral amine synthesis, *Curr. Opin. Chem. Biol.* **2018**, 43, 106–112.
[2] Kim Shortall, Fernando Otero, Simon Bendl, Tewfik Soulimane, and Edmond Magner, Enzyme Immobilization on Metal Organic Frameworks: the Effect of Buffer on the Stability of the Support *Langmuir* **2022**, 38, 44, 13382–13391.