PhD project

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Ni(k)AGARA : Heterogeneous Cascade Oxidations Catalyzed by Mesoporous Artificial Enzymes

Goal

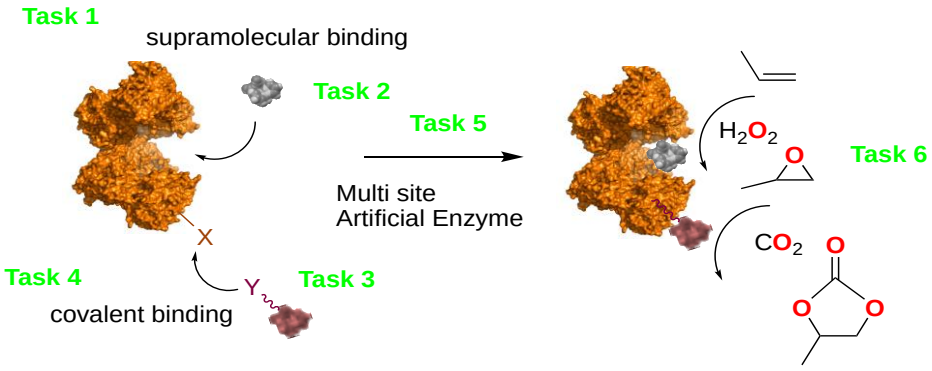
The aim of this project is to develop a new reactivity by combining catalytic systems already known to work efficiently but separately. The PhD student will have to conduct its own project from the ligand synthesis to the set-up of the catalytic probes.

Targeted expertise

Learning how to deal with an interface project. Practice organic and inorganic synthesis with the aim of using the synthesized object or directly as a catalyst either as the active center of an artificial enzyme. Be able to set up the right experiment and analyze the results.

Summary

The interdisciplinary project Ni(k)AGARA deals with the conception of innovative solutions for a sustainable chemistry. It will cover research at the interface of biotechnology and chemistry. Accordingly, the project concerns basic science to develop new catalytic solutions for green chemistry, involving a bio-inspired design of heterogeneous biocatalysts. The outstanding quality of the present project relies into the right combination between sustainability and catalysis, creating new innovative solutions for catalysis while targeting pollutants, or bio-based molecules building blocks. The scientific benefits will be numerous at various levels. Firstly, the consortium will develop new tools to chemically transform proteins crystals and understand the catalytic mechanisms at the molecular level. Secondly, the application for polymer transformation should open new greener routes. The consortium has already validated the relevance of its crystalline artificial metalloenzymes to design new biotechnological solutions and here we propose to go further by creating cascade reactions *in cristallo*. This unique approach will reinstall the CLEC technology in the field of applied catalysis with an ultimate goal of cascade reactions. Fortunately, the technological progress in protein crystallization and the use of robotics will ensure the easiness of solid biohybrids production. A second reading level of the project deals with the search of new reactions processes for high value products combining the valorization of CO_2 with polymer functionalization, a very active field for polymers with low environmental impacts. Indeed, for example, if polyurethane is a widespread class of polymers, ranking 6th among all polymers based on annual worldwide production, they are obtained by reaction with highly toxic isocyanates that need to be replaced by a sustainable approach. Hence, the development of PHUs is an attractive output for industrial applications. According to our valorization unit, the targeted reactions and the products should be of interest for patenting. The position of the consortium, leader in the design of catalysis *in cristallo*,[1] should afford publications in scientific journals at high impact factor.



Technical skills

Organic synthesis – inorganic synthesis – homogeneous and heterogeneous catalysis – crystal growing.
Spectroscopic skills : NMR, EPR, UV-visible, GC and HPLC, Mass spectrometry.

Needed expertise

A real motivation for synthesis (organic and inorganic) and an interest for biochemistry (use of biomolecules).

(1) a) Cavazza, C.; Bochot, C.; Rousselot-Pailley, P.; Carpentier, P.; Cherrier, M. V.; Martin, L.; Marchi-Delapierre, C.; Fontecilla-Camps, J. C.; Menage, S. *Nat. Chem.* 2010, *2*, 1069; b) Lopez, S.; Rondot, L.; Leprêtre, C.; Marchi-Delapierre, C.; Ménage, S.; Cavazza, C. *J. Am. Chem. Soc.* 2017, *139*, 17994.