Heterogeneous chemo-enzymatic catalysis: an optimized immobilization strategy towards sustainability

Keywords

enzyme oriented immobilization, tailored transition-metal-based catalysts, supported chemo-enzymatic (electro)catalysis, porous materials, in operando fluorescence microscopy

Summary

The development of new processes for sustainable chemistry is at the heart of the great challenges of tomorrow. In this prospect, co-immobilizing a synthetic transition-metal-based catalyst and a robust multi-copper oxidase allows to couple a selective oxidation of organic compounds to a safe four-electron/four proton reduction of dioxygen to water. The aim of this project is to study in situ a new generation of supported chemo-enzymatic catalysts developed for sustainable oxidation of organic compounds. These systems will be confined in the pores of tailored 3D materials (indium tin oxide (ITO) 3D-electrodes and macrocellular silica foams), where a control of the orientation of the two catalysts (transition metal complex and enzyme) relative to each other and to the material surface will allow to define unique interfaces. Preliminary results suggest that the support does more than ensuring stability and reusability by playing a role in the catalytic process.[1] Therefore, controlling the organization of the components will allow to tune the reactivity. The multidisciplinary project will integrate various approaches to study the effect of different organizations on catalysis, ranging from materials synthesis and production of the tuned (bio)catalysts; to oriented immobilization of the catalysts into the material and characterization of catalysis via multiple methods (workflow catalysis, electrochemistry, in operando fluorescence microscopy during turnover[2]).

References:

1- F. Yang et al., Biotechnology Reports 2021, 31, e00645;

2- B. Tassy et al., Analytical Chemistry 2020, 92 (10), 7249-7256.

The co-supervisors

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Location

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Doctoral school

Chemical Sciences (ED 250), Aix-Marseille Université (https://ecole-doctorale-250.univ-amu.fr/en)

Expected profile of the candidate

Candidates for the PhD position should have a Masters' degree in chemistry or chemical engineering, with major interest in physical chemistry or analytical chemistry. The successful applicant will have obtained excellent grades in his/her Bachelor and Master's degrees (or equivalent). He/she should be well-motivated, hardworking, willing, and able to work as part of a team. Background / experience in (bio)(electro)catalysis would be beneficial, interest for enzymes and particularly for metalloenzymes is welcome.