

« Hybrid catalysis applied to furfural and carboxylic building-blocks synthesis from biomass » - project HybCat4Bio

Coordinator : Institut Viollette

Partners : UCCS ; platform Equipex Realcat

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This project concerns the development of the coupling of biocatalysis and chemical catalysis (concept of 'hybrid catalysis') for the transformation of molecules from biomass (monosaccharides). Indeed, this innovative concept, which is currently being considered on a global scale, but has so far been little studied, will open new routes for the recovery of biomass-derived compounds for the production of biosourced chemical intermediates (or building-blocks).

The "HybCat4Bio" thesis project concerns the valorization of monosaccharides, mainly pentoses, in the framework of the AAP ISite-ULNE "Sustain". The valorization of biomass for obtaining building-blocks is a very important issue. For example, the hybrid catalysis applied on pentoses can lead to numerous high value-added products such as furfural and carboxylic derivatives whose values are 100 to 1000 times higher than the transformed substrates. For this, we propose an original approach consisting of coupling a heterogeneous catalyst (supported metal catalyst) with enzymatic catalysis (oxidases) in order to carry out all the steps from the pentose to the building-blocks.

However, to complete this project, some bottlenecks will have to be solved:

- The operating conditions of both catalysts must be compatible (at least in order of magnitude) in terms of temperature, pH, typical reaction time. In addition, the enzymatic catalysis of the oxidation of monosaccharides to furfural compounds is favored in water while the chemical catalysis to obtain carboxylic derivatives is favored in organic solvents.
- The heterogeneous and enzymatic catalysts must be stable in the reaction medium for a reasonable time (48 hours minimum).
- The products of one reaction must not poison the other catalysis (for example inhibition or poisoning of the enzyme due to the appearance of carboxylic acids during the chemical catalysis in the reaction medium).
- For the enzymatic reaction, the use of soluble enzymes is a problem for the post-reaction separation of the product (s).

The project will be carried by the Viollette laboratory (ProBioGEM team), which has recognized expertise in enzymology and bioprocess engineering applied to the conversion of biomass into high value-added molecules. This project will be conducted jointly with the UCCS laboratory, recognized for the synthesis and implementation of heterogeneous catalysts mainly for the recovery of biomass-derived molecules. This project will rely on the use of the REALCAT screening platform, allowing high-speed optimization of biotechnological and chemical approaches.

Candidate Profile

- Solid background in biochemistry / enzymatic engineering / chemistry / catalysis
- You have a Master's degree with at least a mention

Skills

Assay of enzymatic activities, enzyme engineering, heterogeneous catalysis, enzymatic catalysis, implementation of hybrid processes, synthesis of advanced materials.

Analysis and interpretation of results, autonomy, rigor, critical thinking, good communication skills and integration into teamwork.

Contact

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The application must contain the following documents:

- A cover letter explaining your interest in this position (max one page)
- A complete CV (max two pages)
- 2 letters of recommendation from the Head of the Training Branch and the tutor of the end of studies
- Copies of relevant diplomas or university certificates