Ircelyon
INSTITUT DE RECHERCHES SUR LA CATALYSE ET L'ENVIRONNEMENT

Ecole Doctorale de CHIMIE C'Durable team PhD proposal: 2022-2025

Valorisation de la biomasse par hydrogénolyse de polyols avec des catalyseurs non-nobles
Valorization of biomass through hydrogenolysis of polyols over non-noble catalysts

PhD supervisors

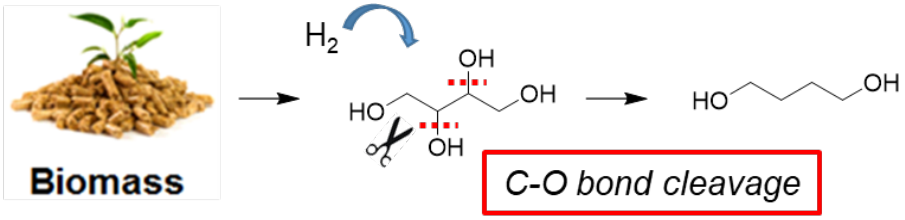
Supervisor: Dr. Noémie PERRET, Chargée de Recherche CNRS; noemie.perret@ircelyon.univ-lyon1.fr

Co-supervisor: Dr. Franck RATABOUL, Chargé de Recherche CNRS; franck.rataboul@ircelyon.univ-lyon1.fr

Profile of the candidate: Good skills in heterogeneous catalysis: synthesis and characterization of catalysts, reaction in liquid phase, chromatography analyses (GC, HPLC). Candidates should hold a Master in Chemistry with at least 5 months internship in a laboratory. Good marks during the master degree are required to get a "Ecole Doctorale de Chimie de Lyon" grant. Send a CV, M1 and M2 marks, recommendation and motivation letters to Dr. N. Perret before 01-04-2022. **S**tarting: October/November 2022.

Keywords: green chemistry, biomass, hydrogenation reactions, heterogeneous catalysts, non-noble metal

Context: This project falls in the promising field of synthesis of chemicals from renewable bioresources. Among them sugar derivatives, which are widely available and renewable, can be transformed into C3-C6 polyols. Glycerol (C3), erythritol (C4), xylitol (C5) and sorbitol (C6) are considered among the most relevant biosourced platform molecules according to the US department of Energy,[1] since there are industrially obtained in large scale from plant-biomass. The selective C-O hydrogenolysis of C3-C6 polyols can produce partially deoxygenated chemicals used for industrial applications. These products are key components in materials such as polyesters, urethane foams and resins, and as intermediates for the preparation of surfactants. A number of previous studies showed that the cooperation between a noble metal (Rh, Ir, or Ru) and an oxophilic promoter (ReO_x, WO_x, or MoO_x) enhanced the catalytic performance in the selective C-O bond hydrogenolysis of polyols.[2] However noble-metals are expensive and their production is concentrated to a limited number of countries. Therefore, it would be interesting to use non-noble metal catalysts for these reactions. This study will focus on the valorization of biomass-based polyols into value added chemicals, using non-noble bimetallic catalysts for sustainable chemical processes



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Project: The project aims at developing heterogeneous catalysts for the hydrogenolysis of polyols. These reactions are conducted in water, in batch reactor, under H_2 pressure. It is known that carbide catalysts (e.g. MoC, W_2C) can exhibit catalytic properties that are similar to noble metals and represent therefore a good and cheaper alternative. For example, we have previously successfully used them for the hydrogenolysis of succinic acid[3] and cellulose. One of the main objectives of this project is the preparation of novel bimetallic catalysts based on carbides and a promoter, immobilized on a support. Different method of syntheses will be investigated. The catalysts will then be characterized by a wide range of techniques such as XRD, ICP, XPS and TEM. The catalysts will be tested first for the hydrogenolysis of glycerol, and then of more sophisticated polyols. The formulation of the catalysts will be optimized in order to reach the highest yield of deoxygenated compounds.

References:

[1] Bozell, J. J.; Petersen, G. R. *Green Chem.* **2010**, *12*, 539.
[2] Sadier, A.; Perret, N.; Pinel, C. *Appl. Catal., A* **2019**, *586*, 117213.
[3] Abou Hamdan, M.; Perret, N. *Ind. Eng. Chem. Res.* **2020**, *59*, 12964.

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