Ph.D. proposal – 2023

Selective synthesis of polyols from renewable resources

Synthèse sélective de polyols à partir de matières premières renouvelables

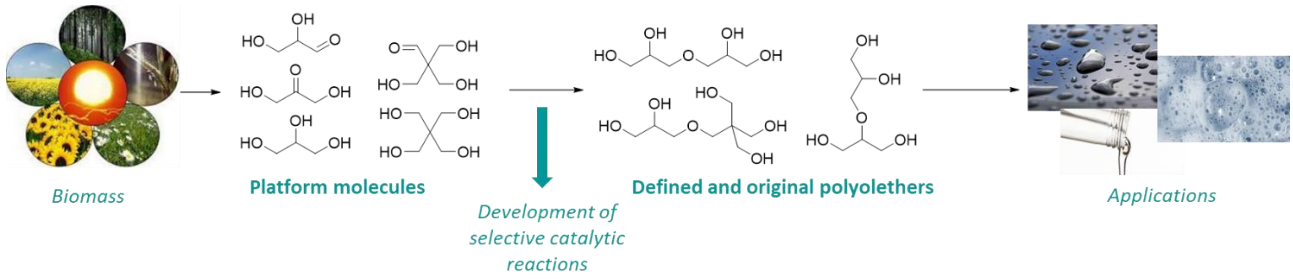
Supervisor: Dr Nicolas Duguet (MCF-HDR) – nicolas.duguet@univ-lyon1.fr – 0472448507
Co-supervisor: Dr Estelle Métay (DR CNRS) – estelle.metay@univ-lyon1.fr – 0472448507
ICBMS UMR 5246 – team Catalysis, Synthesis & Environment (CASYEN)

Key-words: polyols ● Renewable resources ● catalytic methods ●

Context: The use of biomass as a renewable feedstock has been recognized as one of the ways to face the depletion of fossil resources and to limit CO_2 emissions. Biomass represents an important reservoir of polyols as it is mainly composed of starch, cellulose, hemi-cellulose, sucrose, and many more oxygenated compounds. The transformation of renewable biomass to added-value compounds, usually, involves the formation of a key intermediate, often called "platform molecule" or "building-block".[1] However, the range of available polyols is quite small, thus limiting the potential to find new applications. In this context, **there is a need to find and develop original biobased building-blocks with high potential of applications**.

Previous work: For several years, our team is developing green and sustainable catalytic methodologies for the valorization of polyols (glycerol,[2] sorbitan,[3] erythritol,[4] dihydroxyacetone[5] and fructose)[6] towards added-value products such as surfactants, solvents and monomers. Recently, we found that the selective catalytic oxidation of diglycerol gave an original platform molecule, named "diglycerose",[7] thus demonstrating that catalytic reactions are important tools to innovate in this field.

Ph.D. Project: The aim of this Ph.D. proposal is **to develop new selective catalytic methods to prepare original polyols based on renewable resources**. In fact, most polyols, as for example diglycerol, are obtained during oligomerisation of the corresponding monomer and separated according to different ways of purification. In the case of diglycerol, a mixture is obtained. Is there any way to reach defined polyols? Is glycerol able to react with another polyol containing an aldehyde or a ketone function as for example glyceraldehyde and DHA to form to corresponding ether? This first point will be notably investigated in reductive alkylation conditions. Other transformations will be also investigated such as dehydrogenation, selective oxidation and/or borrowing hydrogen conditions.



Candidate profile: The candidate should have a strong background in organic chemistry (M2 degree) and should be motivated to develop catalytic methods in a green chemistry context.

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[1] T. Werpy and G. Petersen, in "*Top Value Added Chemicals from Biomass*". *Results of Screening for Potential Candidates from Sugars and Synthesis Gas*, Vol. 1, US Department of Energy, **2004**.
[2] M. Sutter, L. Pehlivan, R. Lafon, W. Dayoub, Y. Raoul, E. Metay, M. Lemaire, *Green Chem.* **2013**, *15*, 3020–3026.
[3] C. Gozlan, E. Deruer, M.-C. Duclos, V. Molinier, J.-M. Aubry, A. Redl, N. Duguet, M. Lemaire, *Green Chem.* **2016**, *18*, 1994–2004.
[4] A. Herbinski, E. Metay, E. Da Silva, E. Illous, J.-M. Aubry, M. Lemaire, *Green Chem.* **2018**, *20*, 1250–1261.
[5] B. Zhu, D. Belmessieri, J. F. Ontiveros, J.-M. Aubry, G.-R. Chen, N. Duguet, M. Lemaire, *ACS Sustainable Chem. Eng.* **2018**, *6*, 2630–2640.
[6] B. Zhu, G.-R. Chen, N. Duguet, M. Lemaire, *ACS Sustainable Chem. Eng.* **2018**, *6*, 11695–11703.
[7] H. Wang, N. D. Vu, G.-R. Chen, E. Métay, N. Duguet, M. Lemaire, *Green Chem.* **2021**, *23*, 1154–1159.