LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 125, 9052 Gent, Belgium

Coach	Supervisor(s)	Funding
Alexandra Bouriakova	Pedro S.F. Mendes, Jeriffa De Clercq, Joris W. Thybaut	/

Hydrogenolysis of bio-mass derived compounds: exploring the catalytic properties of Cu-based catalysts

Aim

Understanding the relationship between catalyst properties and the hydrogenolysis reaction of bio-mass derived compounds to diols.

Justification

Diols are important chemicals used in numerous applications for instance, as a monomer in the manufacture of polyesters, in printing inks, in disinfectants and in cosmetics. For decades, diols have been produced from petrochemical sources, but the hydrogenolysis of bio-mass derived compounds such as glycerol (which is a side product in bio-diesel production) or furfural (which can be retrieved in lignocellulosic biomass) can be alternative sustainable routes.

Various heterogeneous catalysts are available for hydrogenolysis, which implies first a cleavage of a C-O bond followed by the addition of hydrogen[1]. Cu based catalysts have been intensively investigated due to lower price, compared to noble based catalysts, and their higher selectivity for the cleave of the C-O bonds, compared to other transition metal based catalysts[2]. To improve the catalyst performance (i.e. stability, activity or selectivity), a dopant (i.e. an additional metal) can added deliberately to the catalyst or support. Even more, La as a dopant showed to increase the catalyst stability for glycerol hydrogenolysis. However, the role of the dopants on the nature of the active site, and consequently the catalyst performance , is not fully understand yet due to its complexity. Therefore, the study of furfural hydrogenolysis could provide more insights into the effect of dopants on Cu.

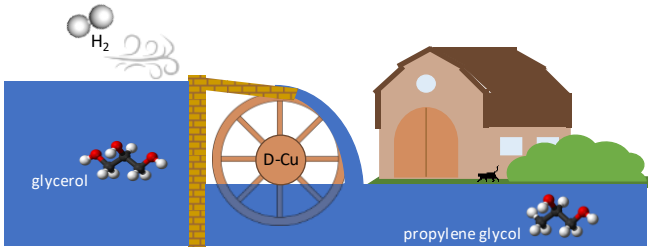

Figure 1. Glycerol hydrogenolysis to 1,2-propanediol over a supported dopant-Cu catalyst

Program

First, the role of the active species in Cu-based catalysts used in hydrogenolysis reactions for different bio-mass derived compounds, such as glycerol and furfural, will be investigated in literature. Different in-house available La-Cu based catalysts will be used in hydrogenolysis experiments under different conditions of temperature and feed (glycerol or furfural) on the high-throughput setup. will be performed. By thorough analysis of the results, the role of the Cu species on the catalyst performance will be established. If needed, in-depth characterization of Cu species will be carried out.

References

[1] A. M. Ruppert, K. Weinberg, R. Palkovits, Angewandte Chemie International Edition 51 (2012) 2564.
[2] Y. Wang, J. Zhou, X. Guo, RSC Advances 5 (2015) 74611.

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