GreenSolRes

Deliverable 2.4

Report on upscaling of catalyst

Demonstration of solvent and resin production from lignocellulosic biomass via the platform chemical levulinic acid

The project leading to this application has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 720695

Bio-based Industries Consortium

BIO-BASED INDUSTRIES Public-Private Partnership

Horizon 2020 European Union Funding for Research & Innovation

About GreenSolRes

The need to establish economic and sustainable large-scale operations for the conversion of renewable resources to chemical building blocks is becoming increasingly urgent in the context of climate change and depleting fossil fuel reservoirs. Pathways for manufacturing of bio-based fuels and chemicals have been developed but most of them rely on sugar and starch crops for feedstock. GreenSolRes aims at a sustainable and competitive industrial production of the platform chemical levulinic acid (LVA) from lignocellulosic wastes and residues originating from forestry and agricultural sector. Further, the conversion of LVA into industry relevant building blocks γ-valerolactone (GVL), 1-methyl-1,4-butanediol (MeBDO) and 2-methyltetrahydrofuran (MeTHF) will take place by new catalytic methods developed during the course of this project. Finally, these chemicals will be upgraded to solvents and resin monomers for the production of high added value adhesives and consumer products. This project was started in September 2016 and has a duration of four years.

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About this document

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Publishable Summary

The goal of WP2 is to deliver an engineering package of a full size levulinic acid hydrogenation plant with a capacity of 10,000 ton per annum as well as a set of samples trials of the three hydrogenation products γ-valerolactone (GVL), 1,4-pentanediol (MeBDO) and 2-methyltetrahydrofuran (MeTHF).
The reaction of levulinic acid to GVL, MeBDO and MeTHF is the second process step in the overall GreenSolRes value chain. In this step two different reactions take place:

1. The multistage hydrogenation of levulinic acid to GVL and MeBDO
2. The dehydrative-cyclisation of MeBDO to MeTHF.

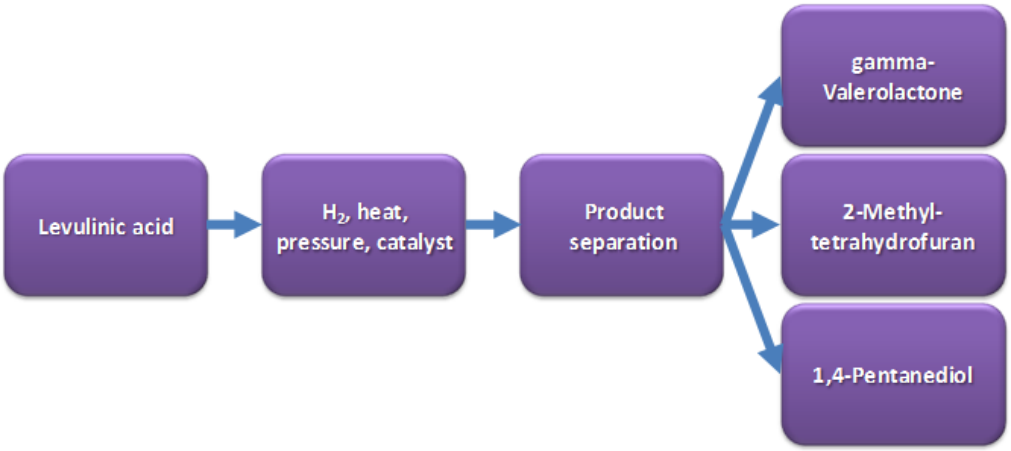

Figure 1: Second part of the value chain demonstration: Hydrogenation of levulinic acid to high-value products and building blocks.

The hydrogenation reaction is a homogeneously ruthenium catalyzed reaction. The catalyst was developed by RWTH [1]. Hybrid Catalysis scaled the synthesis of the catalyst from small scale to kg scale in a 3 step reaction with an overall yield of 54% while employing green solvents such as MeTHF in most of the reaction steps. Samples of catalyst were successfully applied by RWTH in the hydrogenation of levulinic acid to gamma-valerolactone and 1,4-pentanediol.

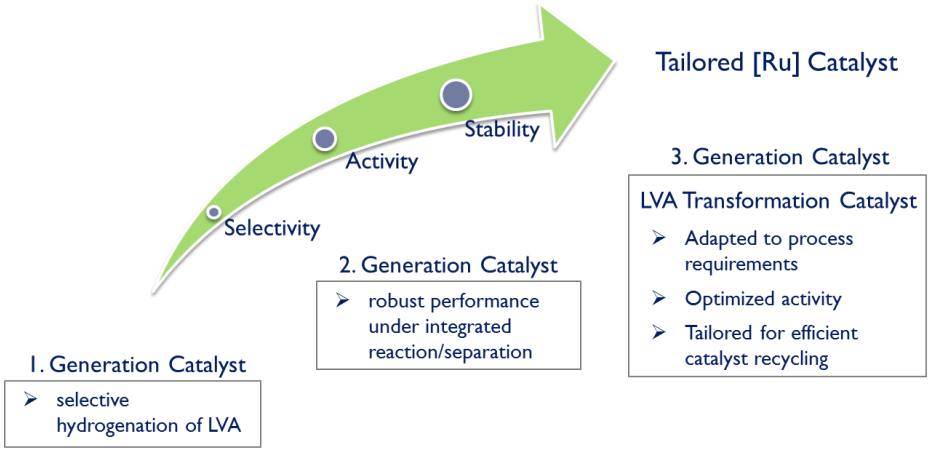

Figure 2: Tailored [Ru] catalyst for hydrogenation of levulinic acid.

[1] J. Klankermayer, W. Leitner, M. Meuresch, **2015**, patent PCT/EP2015/052881

Abbreviations

Ar	aryl
DMSO	dimethylsulfoxide
DIBAL-H	diisobutylaluminium hydride
Et	ethyl
Et-Triphos-Ph	1,1,1-tris(diphenylphosphinomethyl)propane
Et-Triphos-Xyl	1,1,1-tris(dixylylphosphinomethyl)propane
g	gram
GVL	γ-valerolactone
kg	kilogram
L	liter
LG	leaving group
LVA	levulinic acid
Me	methyl
MeBDO	1,4-pentanediol / 1-methyl-1,4-butanediol
MeTHF	2-methyltetrahydrofuran
Me-Triphos-Ph	1,1,1-tris(diphenylphosphinomethyl)ethane
Me-Triphos-Xyl	1,1,1-tris(dixylylphosphinomethyl)ethane
MsO	mesylate
Ph	phenyl
RWTH	Rheinisch-Westfälische Technische Hochschule
THF	tetrahydrofuran
TMM	trimethylenemethane
Xyl	xylyl