Inorganic Materials & catalysis

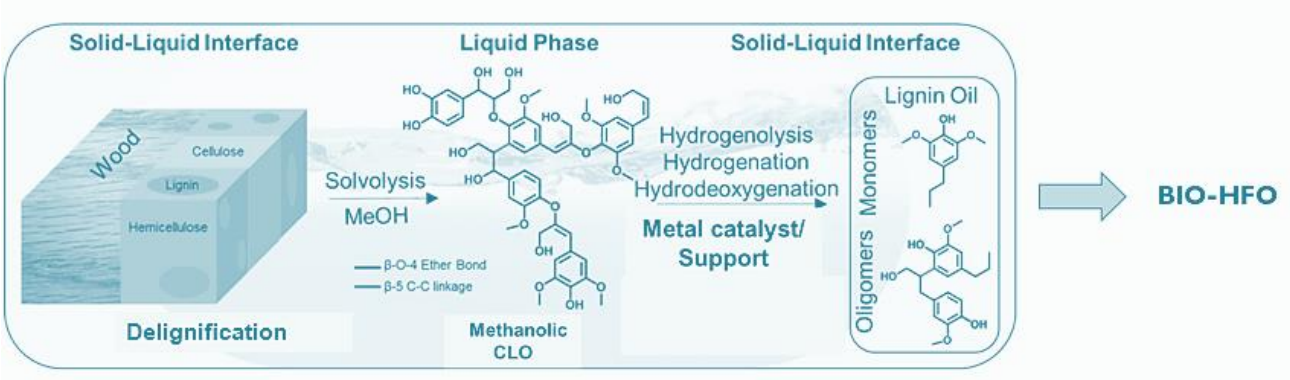
Research Project – Emiel Hensen/Alexandra Radu

INORGANIC MATERIALS & CATALYSIS

Hydrodeoxyenation of CLO towards BIO-HFO fuel over Bifunctional Heterogeneous Catalysts

Background

Lignocellulose is receiving increasing attention to be used as a sustainable alternative to petroleum feedstocks since the emergence of the biorefinery concept. Despite this, the potential of the lignin biopolymer to be converted into useful chemicals or fuels remains relatively untapped. Whilst most depolymerization routes target solely the dominant etheric bond within lignin, novel bifunctional catalysts capable of breaking multiple inter-unit linkages are still to be explored. This project seeks to develop a one-step catalytic conversion of Crude Lignin Oil (CLO) for the production of marine heavy-fuel oil (HFO) through mild hydrodeoxygenation (HDO). The starting point of this conversion route evolves from the CLO end-product resulted from the Methanol solvolysis of wood developed by Vertoro.[1]



To carry HDO, a suitable support doped with redox active metals is employed. Non-precious metals could be for instance nickel, iron, cobalt and alloys of such impregnated on a support. The ability to store and release H_2 makes Ceria particularly useful to be used as a support.[2] Synergetic effects can be achieved by choosing the right metal combination, as well as through interactions with the support. To bypass the classical multi-step wet-chemistry methods, FSP is used for the synthesis of high surface area metal-oxide nanoparticles from appropriate precursors.[3]

During this work, the student will have hands-on involvement at the forefront of heterogeneous catalyst design and characterization. Moreover, valuable experience in the vibrant field of lignin valorisation will be acquired while evaluating product distribution from model compound studies, followed by more challenging CLO feedstocks. Enthusiastic students will be encouraged to optimize the design of such bifunctional catalysts by tuning the support acidity and reaction conditions.

Techniques used:

Flame Spray Pyrolysis (FSP), X-ray diffraction (XRD), X-ray photoelectron Spectroscopy (XPS), Scanning electron microscopy (SEM), N_2 physisorption, NH_3-TPD, CO-TPD, GPC, GC-MS, 2D-NMR.

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[2] T. De Saegher, J. Lauwaert, J. Hanssen, E. Bruneel, M. Van Zele, K. Van Geem, K. De Buysser and A. Verberckmoes, Materials (Basel)., 2020, 13, 1–23.
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