The Quest for Technologies for the Production of Sustainable Fuels and Chemicals from Biomass

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Abstract

The focus of the Huber research group is to develop new catalytic pathways for conversion of biomass into fuels and chemicals. In this presentation we will discuss three different approaches for conversion of convert biomass into fuels and chemicals that are being studied in the Huber research group including: 1) the conversion of biomass into aromatics by catalytic fast pyrolysis, 2) the conversion of ethanol into distillate fuels by Guerbet condensation and etherification, and 3) the conversion of biomass into α,ω-diol.

Catalytic fast pyrolysis involves the direct conversion of solid biomass into gasoline range aromatics in a fluidized bed reactor. This technology has been licensed to Anellotech who has built and operated a fully integrated demonstration facility in Silsbee Texas. Ethanol can be converted into longer alcohols by Guerbet coupling. These longer alcohols can be then etherified to produce distillate boiling range molecules.

We will conclude our discussion by talking about approaches to convert biomass into high value oxygenated α,ω-diol. We will describe a multi-step catalytic approach for conversion of cellulose into 1,6-hexanediol and hemicellulose into 1,5 pentanediol as well as other oxygenated commodity chemicals. Cellulose is first converted into levoglucosenone (LGO) in the condensed phase with dilute acid using a polar, aprotic solvent. The LGO is then hydrogenated into dihydrolevoglucosenone, levoglucosanol, tetrahydrofuran-dimethanol (THFDM).

The THFDM then undergoes selective C-O-C hydrogenolysis to produce 1,6-hexanediol using a bifunctional (Pt-WOx/TiO2) catalyst with > 90% selectivity to 1,6 hexanediol. Tetrol and 1,2,6 hexanetriol can also be selectively produced with this system. The hemicellulose is converted into furfural which then undergoes a four step process to produce 1,5 pentanediol. These biobased molecules provide material scientists with new starting renewable monomers they can use to create new materials.

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Prof. George Huber's lecture will take place at Utrecht University at Tuesday 21 May 2019 and is part of the combined lecture program with Prof. Karsten Reuter (Technical University of Munich). See our Event for more information.