Catalytic conversion of biomass derived platform chemicals to fuel components

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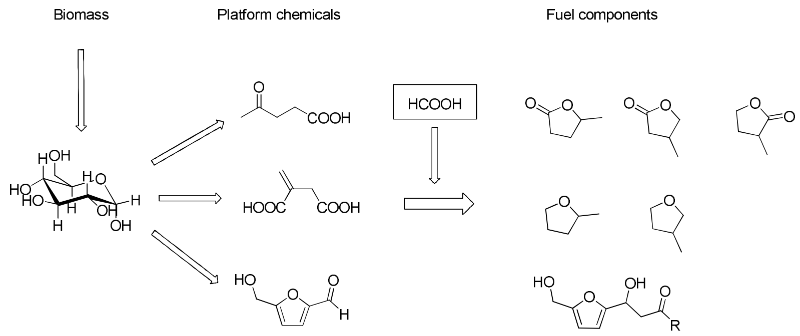
World-wide rising energy demands, limited availability of fossil energy resources and increasing carbon dioxide levels constitute major challenges for all technology based societies. Novel low energy and CO_2-neutral routes to transportation fuels are highly desirable as these fuels need to meet specific requirements with respect to distribution, preparation and combustion. In this context, bio-based raw materials are of fundamental importance.

The cluster of excellence (CoE) ”Tailor-Made Fuels from Biomass” at RWTH Aachen University adopts an interdisciplinary approach for the development of such fuels, through the application of optimized synthesis processes, towards new, biomass-based synthetic fuels, in order to verify their potential, with regard to modern combustion technologies.

Here we describe the chemical/catalytic part of CoE aiming at the development of novel low energy routes for selective transformation of biomass derived platform chemicals potentially useful as new fuel components or fuel additives (Scheme 1). A range of reactions and separation techniques is presented which highlights the enormous potential to arrive at fuel additives or new fuel components for mobile applications. Promising substrates derived from carbohydrates such as levulinic acid (LA), [1] γ-valerolactone (GVL), α-angelicalactone[1] and itaconic acid[2] are transformed by nanoparticle catalysis, homogeneous organometallic catalysis and biocatalysis to differently substituted tetrahydrofuranes and other products which are currently predicted to be of high importance for the design of future fuels. The technology leap for these transformations is generated i.e. by the development of novel catalyst systems and separation techniques employing a range of specially designed ionic liquids (IL) and usage of unconventional solvents like compressed and/or supercritical carbon dioxide.

The focus of the results presented here is on organometallic catalyst/IL-systems, nonclassical and classical metal hydride catalyst systems and nanoparticle catalyst/IL-systems. A variety of transformations is presented with regard to the selective production of fuel components.



Scheme 1.

References

[1] a) A. Corma *et al.*, *Chem. Rev.* **2006**, *106*, 4044-4098; b) A. Corma *et al.*, *Chem. Rev.*, **2007**, *107*, 2411-2502.

[2] I.T. Horvath et al., *Green Chemistry*, **2008**, *10*, 1024-1028.