Catalytic conversion of grass biomass to chemicals and biofuels

D. Licursi[a], A. M. Raspolli Galletti[a], E. Bertolucci[a], M. Giannoni[a], M. Martinelli[a]

[a] Department of Chemistry and Industrial Chemistry, University of Pisa, Via Risorgimento 35, 56126 Pisa, Italy; ***domenico.licursi@virgilio.it***

Lignocellulosic biomass can be converted into platform chemicals, such as 5-hydroxymethyl-2-furaldehyde and levulinic acid (LA), by acid hydrothermal treatment. This route represents a sustainable solution to the increasing demand of these chemicals, allowing security of supply and economic advantage, in particular when cheap raw materials or agricultural residues are employed as substrates. Now we have studied a novel process for the complete and efficient acid-catalyzed exploitation of grass raw biomass. Giant reed, sorghum and miscanthus were used as starting materials. The optimized process allows us to convert the aqueous biomass slurries with high yield (up to 23 wt % with respect to starting dry biomass) to LA using a very dilute proton acid and a temperature range of 150-200 °C. Traditional heating and MW-irradiation were applied in this process. Novel heterogeneous magnetic acid catalysts have been also synthesized and applied in the acid hydrolysis step. LA was successively hydrogenated to γ-valerolactone (GVL) which is not only a sustainable liquid but also a valuable fuel additive and a precursor for new biofuels. The bi-functional (acid and hydrogenating) performances of Ru and Pd heterogeneous catalysts and the optimization of the reactions conditions have been studied [2]. The inexpensive production of GVL directly from renewable biomass with an "one pot process" in water was also performed by adopting heterogeneous catalytic systems under very mild reaction conditions. High yields of GVL (> 20 wt % calculated on the starting weight of dry biomass) were reached. The combined hydrogenation-decarboxylation of levulinic acid and of GVL to give 2-butanol and methyl-THF were also studied in the presence of Ru, Pd and Re catalytic systems. The selectivity of the process is significantly influenced by the reaction conditions as well as by the nature of an eventual heterogeneous acid co-catalysts.

References

[1] A.M. Raspolli Galletti, C. Antonetti, V. De Luise, D. Licursi, N. Nassi, *Bioresources,* **7** (2) (2012) 1824 - 1835.

[2] A.M. Raspolli Galletti, C. Antonetti, V. De Luise, M. Martinelli, *Green Chem.*, **14** (2012) 688-694.