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Preface

Utilisation of biomass for fuels and chemicals: The road to sustainability

The main objective of COST Action CM0903 "Utilisation of Biomass for Sustainable Fuels and Chemicals" (UBIOCHEM)" is to generate a synergistic approach for utilisation of biomass for sustainable fuels and chemicals through cooperation between scientists from different member states and different areas and disciplines. This special issue of Catalysis Today contains a series of papers presented at the first Workshop of COST Action CM0903 (UBIOCHEM-I) held in Cordoba, Spain, from May 13th to 15th, 2010, under the theme "Utilisation of biomass for fuels and chemicals: the road to sustainability". There were more than 100 participants from 21 different countries and the four main topic areas covered, in line with the four different working groups (WGs) in the Action, were as follows:

WG1: *Primary conversion of lignocellulosic feedstocks*: Traditional thermal (pyrolysis or gasification to afford syn gas) or hydrolytic (acid/base of enzymatic) treatments and its improvement through the use of microwaves, ultrasounds and alternative reaction media such as supercritical CO_2 and ionic liquids in order to make them both more effective and environmentally friendlier.

WG2: *Conversion of biomass into energy*: Exploration on the different alternatives to produce energy from biomass.

WG3: *Biomass to materials*: Study of the production of biodegradable films, adhesives and plastics from biomass. It includes both new materials produced via platform chemicals and new materials produced directly from biopolymers such as cellulose, chitin, etc.

WG4: *Platform chemicals*: Valorisation of some platform chemicals that can be produced by biological or abiological processes from biomass.

The main processes involved in the scientific program of COST Action CM0903 are represented in Fig. 1.

This special issue begins with 3 articles based on Plenary Lectures at the Workshop. First, Prof. Sheldon, Chair of COST Action CM0903, places emphasis on one of the key issues and main goals of the Action: the need for establishing a set of metrics for assessing the sustainability of different processes and products. Second, Prof. Centi gives a perspective review analysing the alternative routes in the catalytic transformation of lignocellulosic materials, focusing on the identification of the critical elements for the evaluation of the different routes, providing at the same time an update on the main trends and tendencies in R&D in this field. Finally, Prof. Gallezot presents a cost-effective alternative route to the traditional approach of conversion of biomass to bioproducts through the intermediacy of platform molecules as building blocks. He suggests and exemplifies the possibility to directly convert biomass to end-products, whereby feedstock would afford, for example, biopolymers as high tonnage end-products that could be used without further processing. This approach could also benefit from the singularity of molecules obtained from biomass thus conferring to the final products (e.g. biopolymers) some new properties different to those of similar end-products obtained from fossil fuels, better biodegradability, for example.

Several articles deal with the application of catalysis to biomass conversion. For example, the application of acid catalysts (zeolites, mesoporous materials or sulphated zirconia) in catalytic upgrading of biomass pyrolysis oil and biodiesel production through transesterification or glycerol acetylation. There are also examples of basic catalysts (CaO, Mg–Zr mixed oxides or hydrotalcites) applied to transesterifications, condensation reactions (e.g. furfural with acetone) or etherification of glycerol to polyglycerols. Supported metal catalysts are also used for transformation of cellulose into sugars and alcohols (Pt-modified mesoporous materials) or Fischer-Tropsch synthesis (cobalt alumina systems modified with alkali and alkaline-earth oxides). The use of enzymes in biomass transformation is also well represented by three articles on the production of new generation biodiesel with a low cost lipase *Thermomyces lanuginosus*, the utilisation of beta-xylanase to increase the efficiency of biocatalytic conversion of crop residues to bioethanol and the possibility to use a modified expression of the major hydrolase activator in *Hypocrea jecorina* (*Trichoderma reesei*) to improve enzymatic catalysis of biopolymer degradation.

The development of predictive models to estimate experimental results are also exemplified in an article by Zabanioutou et al., estimating the product yields in biomass pyrolysis.

Plasma gasification, one of the latest and less explored technologies to convert waste materials to useful products is discussed (see article by Grigatiene et al.). Moreover, several articles contain examples of the application of alternative techniques (e.g. ultrasound, microwaves) either in the synthesis of the catalyst or during the reaction itself in order to obtain new and improved results. In the latter case, there is a review by Richel et al. on microwave-enhanced reactions of monosaccharides promoted by heterogeneous catalysts.

Finally, an interesting article reports on the use of microalgae as potential feedstocks for biodiesel production. To this end, algal oil is first extracted and then transesterified with methanol over acid zeolites.

We hope that this special issue will be valuable to the catalysis community both in industry and academia.

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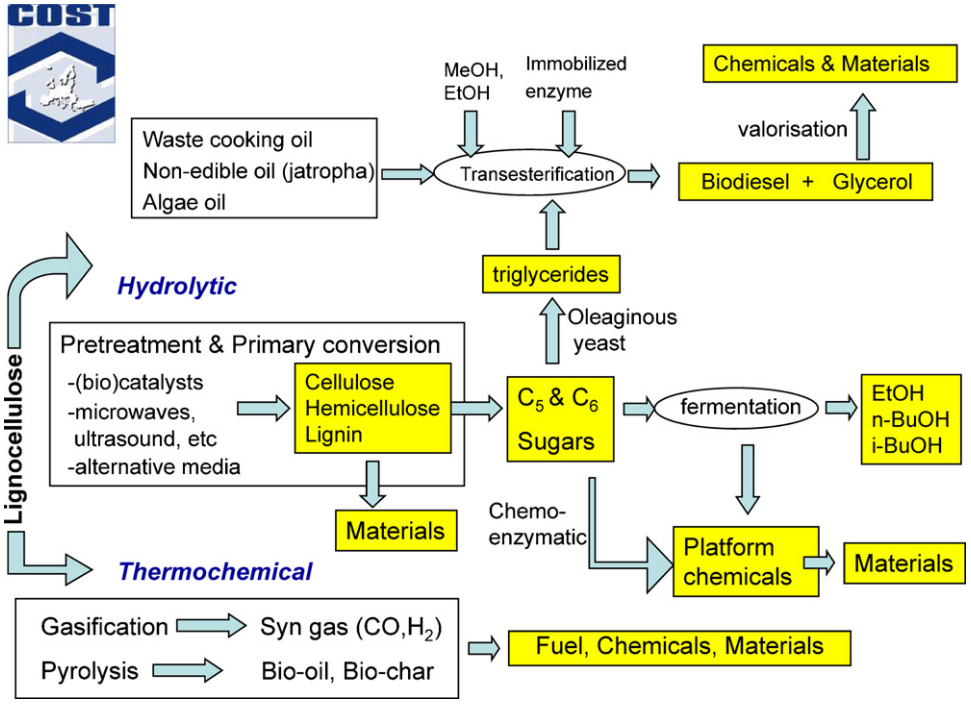

Fig. 1. Pictorial representation of the main processes involved in COST Action CM0903.

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We hope to see you in UBIOCHEM-II which will be part of the conference "Materials and Technologies for Green Chemistry" (5–9 September 2011, Tallinn, Estonia).

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