Valorisation of 5-hydroxymethylfurfural from biomass waste synthesis of fine chemicals through hydrogenation and amination reactions using heterogeneous catalysis

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Currently the challenge is the development of new technologies that will allow the purification of the biomass residues obtaining biomass feed stocks and consequently intermediate platforms, building blocks, secondary chemicals, intermediates and finally high valuable chemicals for products used in pharmaceuticals, foods, agriculture and materials. The production of value added chemicals from biomass derived carbohydrates is an emerging field. The amount of publications in the study of pentose and hexose conversion to furfural and 5-hydroxymethylfurfural (HMF) has considerably increased in the recent years. Specifically, HMF is considered to be one of the most promising platform molecules that can be converted into a variety of interesting chemicals through decarbonylation, decarboxylation, hydrogenation, aldolcondensation, etherification, amination and hydrogenolysis reactions, among others. The valorisation of biomass residues using heterogeneous catalysis has been an important improvement in the fine chemistry field. HMF derived is useful in manufacturing of important products as acids, aldehydes, alcohols and amines. In this work, the selective amination and hydrogenation of HMF through heterogeneous catalysts is proposed to obtain high added value products. Hydrogenation allowed obtaining biofuel additive compounds and the direct reductive amination of HMF using heterogeneous catalysts and NH_3 is presented for first time. In that sense, this work includes the study of different preparation procedures of catalysts and different metal precursors, supports, co-catalysts to modify the metal particle size, metal loading and dispersion, acidity of solids and reactions conditions. The catalytic behavior was analyzed by activity, selectivity and stability of the solids. Both in amination and hydrogenation, some properties as the metal or support nature, metal diameters and the acidity of solids were changed considerably by the conversion and yield to the value added products from HMF. This catalytic behavior was related to the solid properties through different characterization techniques, but in most experiments a maximum conversion was obtained.

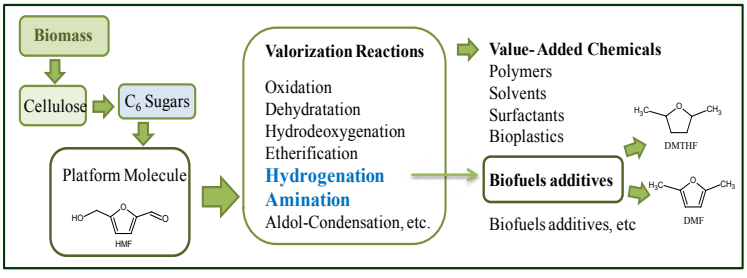

Figure: Biomass transformation to HMF and the reaction network of HMF conversion to chemicals.

Recent Publications:

1. Chimentão R J, Oliva H, Belmar J, Morales K, Mäki-Arvela P, Wärnåc J, Murzin D Yu, Fierro J L G and Llorca J Ruiz D (2019) Selective hydrodeoxygenation of biomass derived 5-hydroxymethylfurfural over silica supported iridium catalysts. Appl. Catal B. Env 241:270–283.

2. Lange J P (2007) Lignocellulose conversion: an introduction to chemistry, process and economics. Biofuels Bioprod. Biorefin. 1:39–48.

3. Corma A, Iborra S and Velty A (2007) Chemical routes for the transformation of biomass into chemicals, Chem. Rev. 107 (6):2411–2502.

4. Chheda J N, Huber G W and Dumesic J A (2007) Liquid-phase catalytic processing of biomass-derived oxygenated hydrocarbons to fuels and chemicals, Angew. Chem. Int. Ed. 46 (38):7164–7183.

5. Roman Y, Barret C, Liu Z and Dumesic J (2007) Production of dimethylfuran for liquids fuels from biomass-derived carbohydrates. Nature 447:982–985.

Biography

Doris Ruiz is an Associated Professor in the University of Concepcion, Chile. She has her expertise in Heterogeneous Catalysis, Enantioselective Catalysis, Hydrogenation and Amination reactions, valorization of compounds from Biomass, Fine Chemistry and Nanomaterials.

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