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Review

Promises in direct conversion of cellulose and lignocellulosic biomass to chemicals and fuels: Combined solvent–nanocatalysis approach for biorefinary

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ABSTRACT

This review surveys sustainable one-pot conversion methods of cellulose into two very important platform chemicals such as 5-hydroxymethylfurfural and isosorbide retaining applications in many fields. Various new techniques based on such as ionic liquids, acid functionalized mesoporous materials, organic acids, functionalized nanoparticles, and mechanocatalytic depolymerization was discussed in detail for the very important direct conversion of cellulose to 5-hydroxymethylfurfural. More emphasis is given on a comparative analysis of recently developed all successful methods for 5-hydroxymethylfurfural production from cellulose in terms of efficiency, selectivity and cost-effectiveness. The article also complements on the promising extraction methods for the 5-hydroxymethylfurfural using special solvents. The importance of another very interesting platform chemical, i.e. isosorbide is also addressed. Several factors of cellulose to isosorbide transformation including metal nanoparticle size, crystallinity order of the cellulose, and extraction medium which controls the rate of conversion and product distillation have been addressed. The article also surveys the potential discoveries in one-pot conversion of cellulose into biofuels. The strategies of cellulose and lignocellulose conversions to compounds with liquid fuel's features have been discussed focusing on the production of γ-valerolactone as important intermediates to access liquid hydrocarbons and valeric esters. Cellulose value-chain for the direct conversions to liquid fuels (e.g. cellulose to levulinic acid platform to obtain valeric biofuels) by using supported nano-structured metal catalysts are emphasized. Overall an analysis of the main prospects and constraints related to the several conversion routes are presented including the critical thinking on the technical barriers, commercial promise, and environmental issues.