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Land and aquatic biomass derived monomers for polymers and fine chemicals

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The depletion of fossil resources and the environmental impact of their extended use are pushing the scientific community to look-for alternative feedstock. The transition from petroleum and natural gas feedstock to bio-based supplies is essential for the sustainability of the chemical industry. New energy-efficient processes, for converting bio based feedstock, will allow industry to produce goods from domestic resources with a substantially lower carbon emission. In this context, biomass represents an abundant low-carbon renewable resource for the production of bioenergy, chemicals and biomaterials, and its enhanced use would address several societal needs. In order to avoid any conflict with food, non-edible biomass should be used such as wood or waste from agro-forest industry or algae. Currently the global yield of agricultural crop residues, excluding grass, varies from ~8 dry Mt ha-1y-1 to ~22 dry Mt ha-1y-1. The main component of such agricultural residues is cellulose, which represents the most abundant form of biomass, and holds impressive potential as alternative to fossil carbon for sustainable production of fuels and chemicals. Cellulose can be hydrolysed into glucose using chemistry or biotechnologies. The isomerization of D-Glucose provides D-Fructose, the platform molecule for making 5-hydroxymethylfurfural (5-HMF), a most promising platform molecule. It is an intermediate in the synthesis of furan derivatives that can replace chemicals sourced from fossil carbon. Developing selective catalysts that may use oxygen as oxidant in water for the synthesis of fine chemicals and monomers for biopolymers is an important issue that targets sustainability in the chemical industry. 5-HMF and its precursors (fructose and glucose) can even undergo ring cleavage to afford di-acids such as succinic acid and oxalic acid. Another important source of monomers for polymers and fine chemicals are monounsaturated fatty acids. Non eatable oleic acid (restaurant oils, oil from algae or from tobacco and other non-eatable plants) can be converted into mono- and di-carboxylic acids that are useful monomers for polymers (the latter) or additives for the cosmetic industry or can be directly used in agrochemistry (the former). This talk will discuss a few options for sustainable conversion of biomass derived compounds into chemicals that may have an industrial utilization.

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