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Dehydration and hydrogenation of carbohydrates with aqueous biphase catalysts (CELL 95)

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Biomass is a green source of raw material, which has the potential to replace fossil raw materials in the production of a large variety of industrial products. The applications of bio-based feedstocks for the production of organic materials are slow to emerge due to the complex nature of biomass and the lack of efficient procedures. If the sustainability of the world will lead to the transition to a hydrogen based energy system, the hydrogen economy can provide cheap hydrogen for the conversion of biomass. The combination of catalytic dehydration of carbohydrates with catalytic hydrogenation of C,C- and C,O-bonds and the catalytic hydrogenolysis of C,O-bonds could lead to a large variety of products. We are investigating aqueous biphase catalysts since carbohydrates are water soluble, the side product is water, and the final products of lower polarity can be readily separated from the aqueous phase. Water-soluble ruthenium complexes prepared in situ using $P(m\text{-}C_6H_4\text{-}SO_3H)_3$, in acidic solution under 80 bar of H_2 at 140°C catalyze the conversion of sucrose to levulinic acid and/or γ-valerolactone, and to the side product formic acid. The same catalyst has quantitatively converted levulinic acid to -valerolactone under the same conditions. Other ruthenium complexes, prepared in situ using PBu_3, under 80 bar of H_2 at 200°C catalyze the conversion of neat γ-valerolactone to 1,4-pentanediol.

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