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A study on depolymerization of cellulosic biomass by solid catalysts

Atsushi Fukuoka

Hokkaido University

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To reduce the emission of greenhouse gas, considerable attention has been focused on the utilization of biomass as renewable resource. One of the key issues in the bio-refinery to synthesize fuel and chemicals is the conversion of non-food cellulosic biomass. Known processes have difficulties in cost, activity, separation and reusability of catalysts, which we have desired to overcome over many years. Solid catalysts have an advantage in separation and applicability of wide rage of reaction conditions; however, the biomass conversion by solid catalysts has not been well studied.

We discovered that solid catalysts containing Pt or Ru promote the hydrolysis of cellulose to glucose which is further hydrogenated to give sorbitol. Then, we aimed for the high-yield synthesis of glucose from cellulose and found that low-cost active carbons with alkali-activation or air-oxidation show high catalytic activity. Mix-milling of catalyst and substrate greatly improves the glucose yield up to ca. 90%, and C5-C6 sugars are obtained from bagasse pulp with high yields and selectivities. The carbon catalysts are durable and reusable in recycle runs.

We have also demonstrated that weak acids such as COOH are active sites for the cellulose hydrolysis, which mimics the mechanism of enzymes.

Our findings enable high efficiency of depolymerization of cellulose that has been the big challenge in bio-refinery, and they will devote the implementation of green sustainable chemistry.