Heterogeneous hydrogenation and oxidation catalysts for the synthesis of chemicals from biomass-derived sugars

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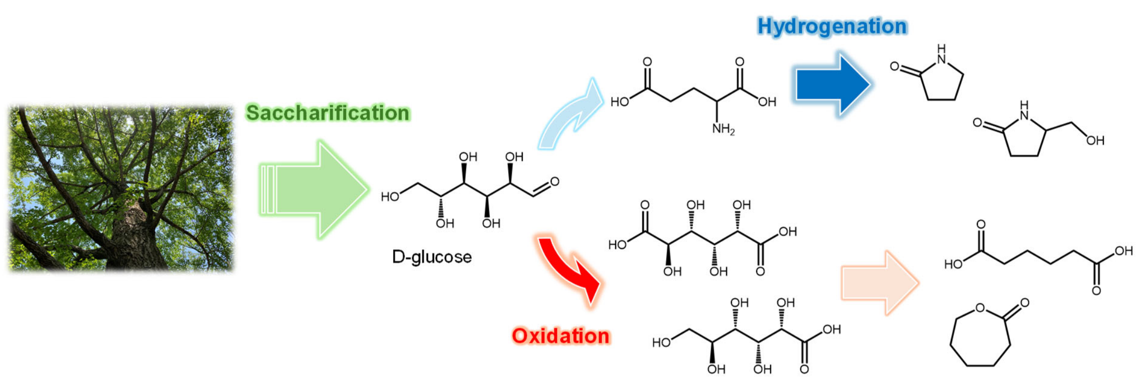
Biomass is attracting attention as a substitute for petroleum and natural gas. Cellulose, which accounts for approximately one-third of the composition of woody biomass, is non-edible and therefore well-suited as a sustainable feedstock. Glucose production via the saccharification of cellulose has been extensively studied, and we have reported a reaction system that efficiently produces glucose using carbon-based solid-acid catalysts [1].

Glutamic acid is produced industrially by fermenting glucose. We have previously reported a method for synthesizing 2-pyrrolidone from glutamic acid using Ru/Al_2O_3 [2]. In this reaction, glutamic acid is readily converted to pyroglutamic acid, followed by hydrogenation to pyroglutaminol, which subsequently yields 2-pyrrolidone. Furthermore, it has been found that Ru catalysts can selectively produce pyroglutaminol by precisely supporting nanoparticles on large-pore zeolite. We have also been working on the hydrogenation of other amino acids. In particular, we have reported that a Pt-Mo catalyst can convert L-proline to L-prolinol with an enantiomeric excess of over 99% [3]. These nitrogen-containing compounds possess robust molecular structures and biocompatibility and are widely used in manufactured products such as synthetic fibers, pharmaceuticals, and cosmetics.

Recently, we have been studying the oxidation of glucose, which can produce glucaric acid and gluconic acid. Although precious metal catalysts are typically used for this oxidation reaction, their high cost and regional scarcity pose challenges for practical application. The use of non-precious metal oxide catalysts operating via the Mars-van Krevelen mechanism could help resolve these issues. We have found that MnO_2 yields more glucaric acid than supported Pt catalysts. If such oxidation products can be converted into adipic acid and ε-caprolactone—raw materials for polyesters and polyamides—via hydrodeoxygenation.



References 1) S. Suganuma, et al., *J. Am. Chem. Soc.* 130(38), *12787–12793* (2008). 2) S. Suganuma, et al. *ChemSusChem* 12(7), 1381-1389 (2019). 3) C. Kaku, et al., *ChemCatChem*, 14(19), e202200399 (2022).

Biography (For Plenary, Keynote, and Invited Speakers)

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Personal History:
Satoshi Suganuma received his Ph.D. from Tokyo Institute of Technology in 2012 under the supervision of Prof. Michikazu Hara. He then worked at Cataler Corporation. He was appointed Assistant Professor at Tottori University in the group of Prof. Naonobu Katada (2014–2018), and subsequently junior associate professor (until 2020) and associate professor (until 2023) in the same group. Since 2023, he has been pursuing research as an associate professor in the group led by Prof. Kiyotaka Nakajima. He has received some awards, including the Japan Petroleum Institute Award for Encouragement of Research and Development (2022).

Research Keyword (3-5 keywords use commas to separate each word):
Heterogeneous catalysis, Biomass conversion, Hydrogenation, Oxidation