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SELECTIVE OXIDATION OF SUGARS AND ALCOHOLS USING GOLD BASED CATALYSTS

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PURPOSE OF THE ABSTRACT
SELECTIVE OXIDATION OF SUGARS AND ALCOHOLS USING GOLD BASED CATALYSTS

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Oxidation of sugar and alcohols to acids or aldehydes has actively investigated over more than 50 years. The received biodegradable products like gluconic acid open up a wide field of application range from food and detergent industry to cosmetic and medicine.
It has been shown that gold supported on metal oxides prepared by deposition precipitation and incipient wetness is highly active and selective depending on the presence of small gold particles.

In the past Thünen researchers showed that for the selective catalytic oxidation of D-glucose supported gold catalysts like Au/Al2O3 or Au/TiO2 have been found to be very selective, active and long-term stable under mild reaction conditions. The highest yield of the oxidation product sodium D-gluconate was >99 % with the use of 0.25 wt% Au/Al2O2 at 40°C and a pH of 9 in a continuous process.

Current research activities show further interesting and promising fields of application for gold based catalyst oxidation reactions. We are just focused on two different oxidation reactions the oxidation of 5-hydroxymethylfurfural (HMF) to the monomer furandicarboxylic acid (FDCA) and the oxidation of monoethylene glycol (MEG) to generate glycolic acid (GA).

HMF and its various derivatives are very interesting biobased chemicals which are useful additives, solvents, plasticizers and especially monomers for polymers. The oxidation product FDCA with its structural similarity to terephthalic acid serves as a green alternative in the plastic polyethylene terephthalate (PET). For HMF oxidation different mono- and bimetallic catalysts were tested and the influence of temperature and kind of base were investigated. The best result with high selectivity and excellent activity was achieved while using a bimetallic catalyst. HMF was oxidized to FDCA using a 0.1 wt% AuPt(9:1)/CeO2 catalyst prepared by impregnation method with a 98 % yield in a basic aqueous solution at 120°C.

A current and new application of gold catalysts is the oxidation of MEG to GA. Starting with bio-MEG leads to biobased GA which can act as monomer for plastic polyglycolic acid (PGA). PGA is biodegradable and has an excellent barrier property that is why it is highly suitable for food packaging. For MEG oxidation we used the same

low loaded bimetallic catalyst as we used in the HMF oxidation (0.1wt% AuPt(9:1)). Optimization of catalyst preparation method and investigation of pH, temperature and MEG concentration leads to a GA yield of about 80 % with a selectivity of 90 % in basic aqueous solution at 70°C. The used catalyst showed very good activity (>1.000 mmolglycol*gAu-1*min-1) and an extremely high educt to metal mole ratio of >20.000 is achieved.

These results clearly show the diversity and the different application for the use of gold catalysts in oxidation reactions.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS
gold catalyst | oxidation | furandicarboxylic acid | glycolic acid

BIBLIOGRAPHY