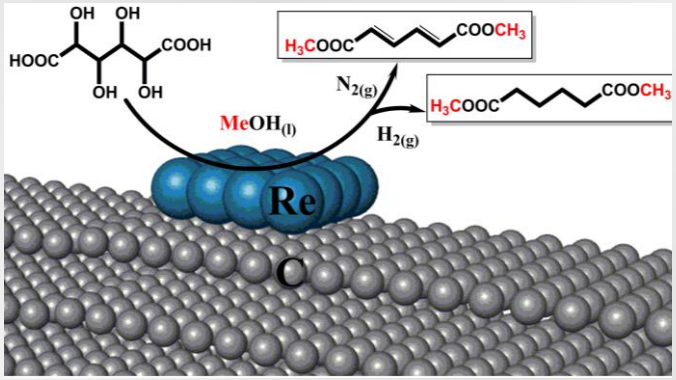
NATIONAL INSTITUTE OF CHEMISTRY

RESEARCH DOMAINS: Bio-based monomers, Catalysis

INDUSTRIES: Textile, Plastics, Automotive, Coatings

SUSTAINABLE PROCESS FOR PRODUCING MUCONIC, HEXENEDIOIC AND ADIPIC ACID (AND THEIR ESTERS) FROM ALDARIC ACIDS BY HETEROGENEOUS CATALYSIS



Adipic acid is produced in 3.7 billion kg annually; the market exceeds $7 billion per year and more than 60 % of the total output is used as monomer for the production of nylon 66 (polycondensation reaction with hexamethylene diamine). Currently, adipic acid is produced from non-renewable resources (crude oil based cyclohexane) in a process that uses corrosive nitric acid and produces NO_x emissions. The highly exothermic oxidation step must be carried out at a very low conversion step to run safely, which increases the cost of the process.

Our invention solves the problems outlined above and features a sustainable process in which adipic acid (and its esters and unsaturated derivatives) is produced from bio-based aldaric acids (which are formed by oxidation of glucose or other sugar related compounds) by selective removal of hydroxyl groups. Our process is the first in which aldaric acids are selectively dehydroxylated over heterogeneous catalysts. The invented process can eventually compete with or replace an industrial process because it uses heterogeneous catalysts that can be easily separated from the reaction mixture or can be fixed in continuous fix-bed reactors.

TYPE OF COOPERATION
Technology licensing opportunities

INTELLECTUAL PROPERTY
EP19192802.7

DEVELOPED BY
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MORE INFORMATION ABOUT THE INVENTION

Technology

The Institute's invention is a process based on selective dehydroxylation of aldaric acids derived from C6 oxidized sugars. The selective dehydroxylation is carried out in the presence of a heterogeneous carbon supported rhenium catalyst (Re/C) and a short chain primary or secondary alcohol (MeOH, EtOH, 2-PrOH,...). Under an inert (N_2) atmosphere, unsaturated dimethyl ester of a C6 dicarboxylic acid is formed. If H_2 is present in the gas phase, it is dissolved in MeOH and adsorbed on the catalyst surface, where it hydrogenated double bonds resulted as dimethyl adipate. Dimethyl adipate can be used directly as a monomer in the polycondensation reaction with hexamethylene to form 6,6-nylon or it can be hydrolyzed under acidic conditions to adipic acid.

Main advantages

- Highly selective process with high yields (> 95 %) of dimethyl adipate and unsaturated esters;
- Use of heterogeneous catalysts provides easy separation and recycling;
- Simple solvent recycling through distillation;
- No formation of hazardous by-products;
- Sustainable process for the production of biobased adipic acid

Key words

Bio-based monomers, Heterogeneous catalysis, Aldaric acid, Adipic acid

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