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## PRODUCTION OF 2,5-FURANDICARBOXYLIC ACID FROM FRUCTOSE - A SIMPLE AND HIGH SELECTIVE PROCESS

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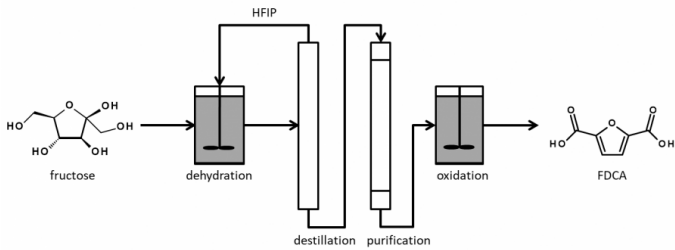
### PURPOSE OF THE ABSTRACT

The production of 5-hydroxymethylfurfural (HMF) from renewables received increasing attention, because of its possible application as building block for sustainable polymeric materials and fuels. The unstable intermediate HMF is synthesized by acid-catalyzed dehydration of fructose. Via selective oxidation of HMF, catalyzed by Au or Pt supported metal oxides, 2,5-furandicarboxylic acid (FDCA) is received. FDCA is a precursor for the production of bio-based poly(ethylene-2,5-furanoate) a biobased polyethylene terephthalate substitute. The entire process from carbohydrates to FDCA is rarely described in literature. We present the complete reaction pathway from fructose to the monomer FDCA, with high HMF and FDCA selectivities.

A synthesis procedure for the key intermediate HMF from renewable resource fructose was developed. We used hexafluoroisopropanol (HFIP) as a new and unknown monophasic reaction solvent for the fructose dehydration in combination with a heterogeneous catalyst and water. HFIP is a low boiling fluoruous alcohol (bp. 58 °C). Hence HFIP can be recovered cost-efficiently by distillation and reused in successive reactions. Different heterogeneous catalysts were screened for the HFIP/water system in batch experiments. The best results were obtained for acidic macroporous ion exchange resins. The influence of various reaction conditions was evaluated. Up to 76 % HMF yield was achieved at optimized reaction conditions for high initial fructose concentration of 90 g/L. The catalyst can easily be recovered by filtration and reused several times. After the separation of HFIP from the obtained reaction solution a HMF containing aqueous solution is available for the subsequent HMF oxidation.

First the inhibiting factors of the aqueous HMF reaction solution containing byproducts (formic acid, levulinic acid and humins) on the HMF oxidation were identified. The catalyst was deactivated by levulinic acid and humins. Consequently the obtained HMF reaction solution has to be purified. Different purification methods for the aqueous HMF containing reaction solution like filtration, extraction and adsorption were investigated and assessed for their HMF purity. The received purified reaction solutions were tested in the HMF oxidation at the previously optimized reaction conditions. Excellent FDCA yields of 99 % were obtained by the purification of the reaction solution with basic ion-exchange resins and the bimetallic catalyst 0.1 wt% AuPt/CeO<sub>2</sub> (Au:Pt = 9:1) in a basic aqueous solution at 120 °C.

## FIGURES



### FIGURE 1

Process scheme

The production of 2,5-furandicarboxylic acid from fructose.

### FIGURE 2

### KEYWORDS

FDCA | HMF | fructose | purification

### BIBLIOGRAPHY