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One-pot synthesis of dimethyl succinate from D-fructose with Amberlyst-70 catalyst

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PURPOSE OF THE ABSTRACT

Dimethyl succinate (DMS), one of the important succinates, has versatile applications in various industries. For example, DMS has been widely used as food additives, as well as in the manufacture of fragrances, pharmaceuticals, agrochemicals and other fine chemicals [1?3], and it is one of the solvents in the commercial dibasic esters mixture [4]. Therefore, the research on DMS synthesis is always a hot topic in both academia and industry.

Generally, DMS is produced from SA via methyl-esterification using sulfuric acid as catalyst. Recently, more efforts have been devoted on this reaction using heterogeneous catalysts to overcome the drawbacks with homogenous catalysts, such as system corrosion, catalyst recycle, product separation etc.. Fabian et al. supported methanesulfonic acid on alumina, and obtained 97 % of DMS yield at 80 °C for only 8 min under microwave irradiations [5]. Zhang et al. developed a poly ionic liquid-based catalyst, which also showed an outstanding esterification of SA to DMS (~100 % yield) at 85 °C [6]. More recently, Jumanah et al. applied halloysite, a natural clay with a hollow tubular structure, for the esterification of SA, and 96 % of DMS could be produced at 170 oC for 24 h [7]. On the other hand, new routes from different starting materials, such as succinic acid anhydride [2], cis-butenedioic anhydride [8], 1,4-butanediol [9], and levulinic acid/ester (LA/E) [1,3,10,11] have been explored for the synthesis of DMS. Among them, the way from LA/E (which can be readily produced from lignocellulosic carbohydrates) via Beayer-Villiger (B-V) oxidation, is more preferable considering both the atom economy and biomass valorization [11,12].

Based on our previous work [13], we developed in this study a metal-free catalytic process for one-pot synthesis of DMS directly from D-fructose. The catalytic performance of different catalysts and other experimental factors, such as temperature, time, oxygen pressure, as well as feedstock variation were investigated in detail. Additionally, the catalyst stability as well as the reaction pathway were also carefully discussed.

FIGURES

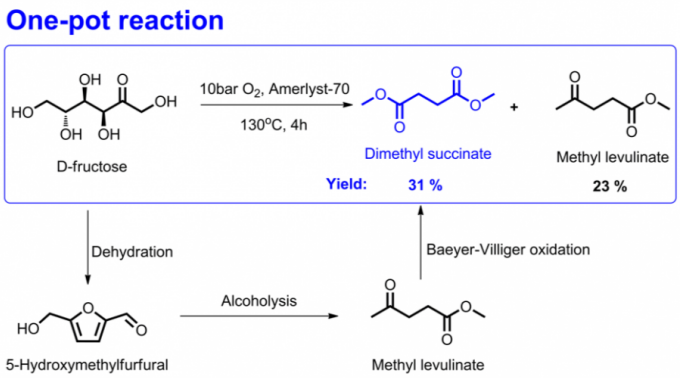

FIGURE 1

Scheme 1

Direct synthesis of dimethyl succinate from D-fructose in the presence of Amberlyst-70

FIGURE 2

KEYWORDS

dimethyl succinate | heterogeneous catalysis | metal free catalyst | one pot multi step catalysis

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