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Exploring the activity of Hydrotalcites in the synthesis of branched sugars towards the production of polyol-based flame retardants

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PURPOSE OF THE ABSTRACT

Aside from their use as precursors in a variety of chemical materials ranging from surfactants and plasticizers to polymer crosslinkers, branched polyols have gained additional interest due to their ability to be converted by esterification into lubricants and moisturizers or, more importantly, into green flame retardants by phosphorylation reaction as a direct replacement for bromine and chlorine-containing alternatives.

Therefore, the development of an efficient and sustainable approach for the synthesis of branched polyols is of great interest. Thus, the objective of this work is to realize the condensation of Dihydroxyactone into branched sugars (Dendroketose) by means of a stable and robust heterogeneous catalysis in order to obtain the corresponding branched polyols via hydrogenation.

In terms of heterogeneous basic catalysts, hydrotalcites are one of the most important candidates to realize the base-catalyzed condensation of dihydroxyacetone. This is due to their interesting structural properties, their ease of synthesis, and the various active sites that lead to the formation of the carbon-carbon bond via aldolization. However, their stability has been questioned sometimes and therefore deserves a focus point.

Our approach consists in studying the activity of hydrotalcite in condensation chemistry as a function of its structure (layered material or mixed oxide), its surface area and its composition (interlayer anion). These different parameters define the strength, the nature (Lewis or Bronsted), and the accessibility of the different active basic sites which have been investigated by means of FT-IR spectroscopy, nitrogen physisorption, and XRD measurements. Interestingly, additional optimization studies were conducted in order to improve the stability of the catalyst and subsequently promote a successful hydrogenation process.

Thus, the gain in mechanistic insights allowed the selection of an adapted pretreatment process that improves the properties and stability of hydrotalcites as heterogeneous catalysts leading to excellent condensation yields and selectivity.

In this presentation, we describe the activity and stability of reconstructed hydrotalcite, which is successfully applied for the formation of branched sugars under mild conditions and suitable for late stage functionalization. The results of the catalyst characterization will be discussed in relation to the conversion rate and selectivity.

FIGURES

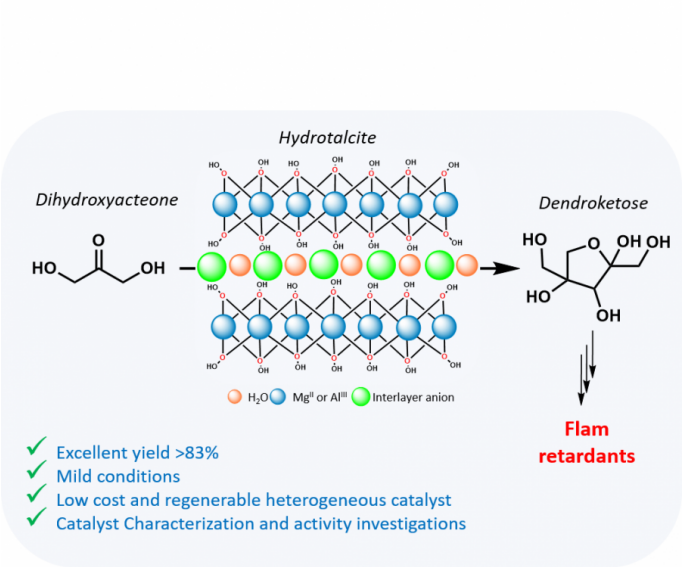

FIGURE 1

Hydrotalcites activity in the synthesis of branched sugars toward the production of polyol-based flame retardants

Scheme 1

FIGURE 2

KEYWORDS

Hydrotalcite | Branched poyols | Flam retardants | Heterogeneous catalysis

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