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Valorization of Biomass-derived Feedstocks with Modified Aluminum Phosphate Catalysts

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PURPOSE OF THE ABSTRACT

Catalytic conversion of renewable lignocellulosic biomass to chemicals and potential fuels is a highly relevant topic for dealing with global challenges such as environmental preservation and the future energy demand. Especially, the synthesis of value-added furanic chemicals and derived diesel and jet fuel-range hydrocarbons with heterogeneous zeolite/zeotype catalysts are of interest, due to the common use of such catalysts in industry and their tunable nature of, e.g. porosity and acidity/basicity as well as modification by promoters [1].

Furfural (FF) can be produced industrially from lignocellulosic biomass and is an attractive precursor for the syntheses of renewable furanic chemicals [2]. Synthetic transformations of FF can proceed either via the aldehyde group or the furan ring and include reactions such as, e.g. hydrogenation, oxidation, acetalization, acylation, aldol condensation and amination. In particular, the reduction of FF to furfuryl alcohol (FA) by catalytic transfer hydrogenation (CTH) using alcohols as hydrogen donors are considered a benign and green protocol. However, also the conversion of FF by reductive etherification to FA ethers, acetalization to FA acetals as well as aldol condensations with other carboxides to obtain jet fuel (C9-14) and diesel (C12-20) range compounds are synthetic strategies of high interest.

Aluminum phosphate (APO-5) is a neutral zeotype material, but its Al/P ratio can be altered to generate acidic/basic sites and metal-species can be introduced to promote specific catalytic transformations. In this work, such modified APO-5 catalysts are demonstrated to be efficient, selective and durable solid catalysts for the valorization of FF and other industrially relevant bio-derived carboxides into renewable fuel additives and polymer precursors (Figure 1) [3-5].

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FIGURES

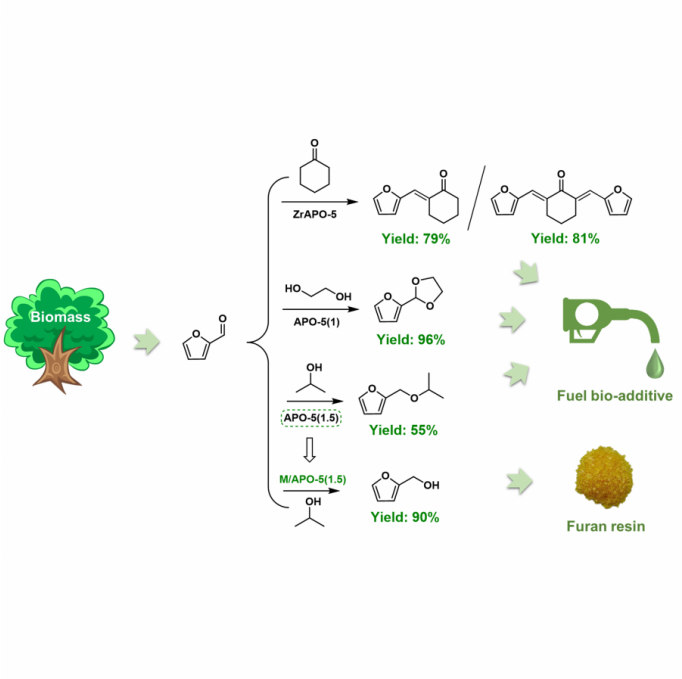

FIGURE 1

Figure 1

Valorization of biomass-derived furfural into renewable fuel additives and polymer precursors with modified aluminum phosphate (APO-5) catalysts

FIGURE 2

KEYWORDS

biomass feedstocks | aluminium phosphate catalysts | furanic chemicals | jet and diesel fuels

BIBLIOGRAPHY

[1] Serrano, D.P, Melero, J.A., Morales, G., Iglesias, J., Pizarro, P. Catal. Rev. 60, 1 (2018).
[2] Meng, Q., Hou, M., Liu, H., Song, J., Han, B. Nature Commun. 8, 14190 (2017).
[3] Fang, W., Riisager, A., Appl. Catal., B: Environ. 298, 120575 (2021).
[4] Fang, W., Riisager, A. ACS Sustainable Chem. Eng. (accepted).
[5] Fang, W., Liu, S., Schill, L., Kubus, M., Bligaard, T., Riisager, A. ACS Catal. (accepted).