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Data Article

Hydrogenation and hydrodeoxygenation of biomass-derived oxygenates to liquid alkanes for transportation fuels

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ABSTRACT

An attractive approach for the production of transportation fuels from renewable biomass resources is to convert oxygenates into alkanes. In this paper, C₅–C₂₀ alkanes formed via the hydrogenation and hydrodeoxygenation of the oligomers of furfuryl alcohol (FA) can be used as gasoline, diesel and jet fuel fraction. The first step of the process is the oligomers of FA convert into hydrogenated products over Raney Ni catalyst in a batch reactor. The second step of the process converts hydrogenated products to alkanes via hydrodeoxygenation over different bi-functional catalysts include hydrogenation and acidic deoxidization active sites. After this process, the oxygen content decreased from 22.1 wt% in the oligomers of FA to 0.58 wt% in the hydrodeoxygenation products.

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Specifications Table

Subject area	Biomass
More specific subject area	Bioenergy
Type of data	Table, figure

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55	How data was acquired	Gas chromatography-mass spectrometry (GC-MS), gas chromatography (GC), Fourier Transform infrared spectroscopy (FTIR), X-ray diffraction (XRD).
56	Data format	Analyzed
57	Experimental factors	Prepared long chain alkanes with FA condensate as raw materials.
58	Experimental features	Content data gathered after the run of the reaction
59	Data source location	Zhengzhou, China
60	Data accessibility	The data are with this article
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Value of the data

- This data shows the theoretical content of C, H, O in the oligomers of FA and elemental analysis of hydrogenation products.
- This data provides the result of the hydrogenation products and hydrodeoxygenation products GC-MS spectra, structural formula and peak flowing out time.
- This data given the power X-ray diffraction (XRD) patterns of fresh catalysts and there average particle sizes of metal site.
- This data provides simulated distillation curves for different high-boiling components in the hydrodeoxygenation products.

1. Data

The data in this data article has been gathered under a “The study of carbon-carbon bond forming of biomass-derived furfuryl alcohol by self-condensation and subsequent hydrogenation 21376226” run under the National Natural Science Foundation of China program funded by the state government of China. Table 1 shows the result analysis of hydrogenation products over different reaction temperature. Table 2 shows the result of hydrogenation products by GC-MS analysis. Table 3 shows the theoretical content of C, H, O in the oligomers of FA and elemental analysis of hydrogenation products. Table 4 shows the alkane carbon yield and TOF under different catalysts. Fig. 1 shows the GC-MS chromatogram of hydrogenation products in reaction conditions of 12 g oligomers of FA, 5 g Raney Ni, 60 g THF, 6 MPa H₂, reaction 4 h. Fig. 2 shows FT-IR spectra of the oligomers of FA and hydrogenation products in reaction conditions of 12 g oligomers of FA, 5 g Raney Ni, 60 g THF, 6 MPa H₂, reaction 4 h at different temperatures, (a) the oligomers of FA; (b) 110 °C; (c) 130 °C; (d) 150 °C. Fig. 3 shows power X-ray diffraction patterns of fresh catalysts. Table 5 shows average particle sizes of metal site in different catalysts (Figs. 4–8 and Table 6).

Table 1

The result of hydrogenation products over different reaction temperature.^a

Reaction temperature (°C)	The H ₂ consumption (mol)	The mass of hydrogenation products (g)	Carbons distribution C ₅ -C ₂₀ (%) ^b			
			C ₅	C ₆ -C ₁₀	C ₁₁ -C ₁₅	C ₁₆ -C ₂₀
130	0.17	9.27	4.27	30.01	32.18	33.54
150	0.24	8.57	4.94	38.32	34.21	22.53

^a Conditions: 12 g oligomers of FA, 5 g Raney Ni, 60 g tetrahydrofuran (THF), 6 MPa H₂, reaction 4 h in a batch reactor of 300 mL.

^b Relative peak area.

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