Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supporting Information

for

Catalytic transfer hydrogenation of levulinic acid to gamma-valerolactone over zirconium-based FDCA hybrid: Insights into the effect of heteropoly acid

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1. Supplementary Figures

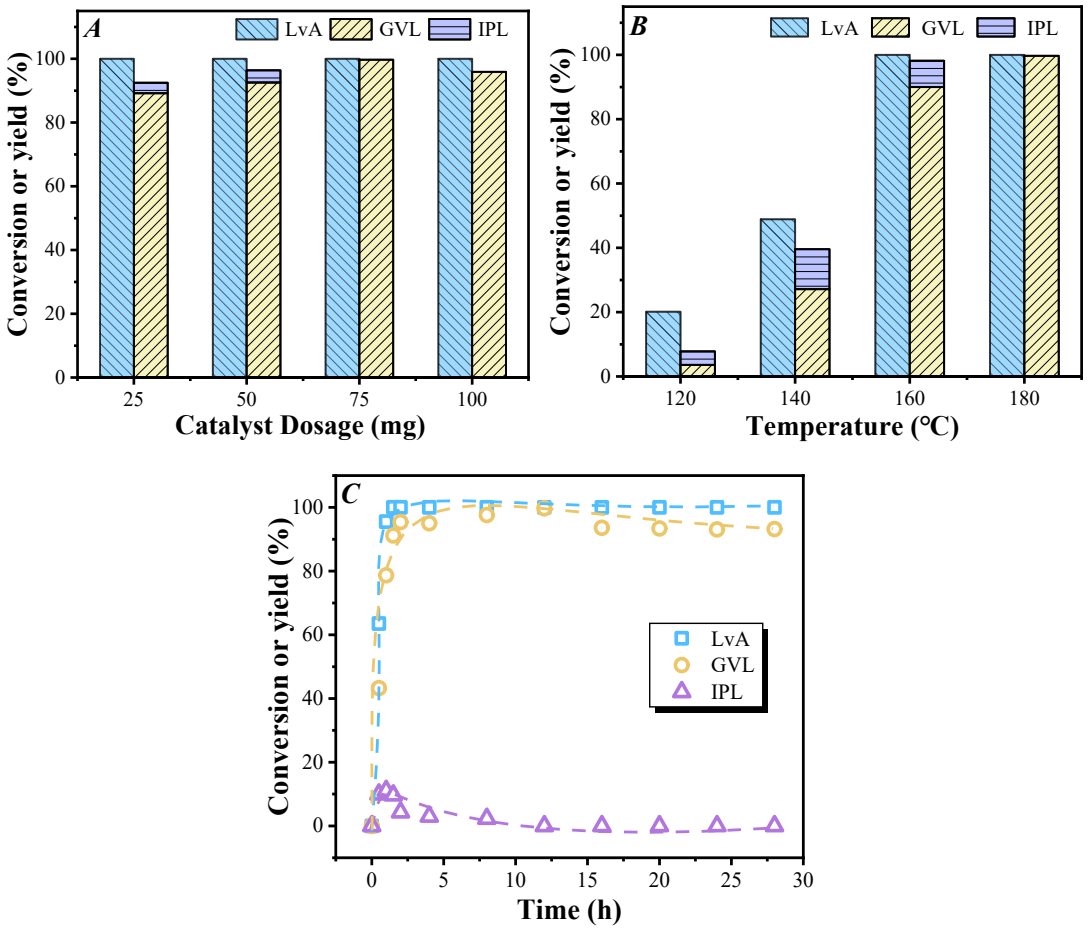

Figure. S1. Effect of the catalyst dosage (A), reaction temperature (B) and time (C) on CTH of LvA to GVL with Zr-FDCA-15HPWO. (Reaction conditions: 2 mmol LvA, 20 mL 2-propanol, 75 mg catalyst.)

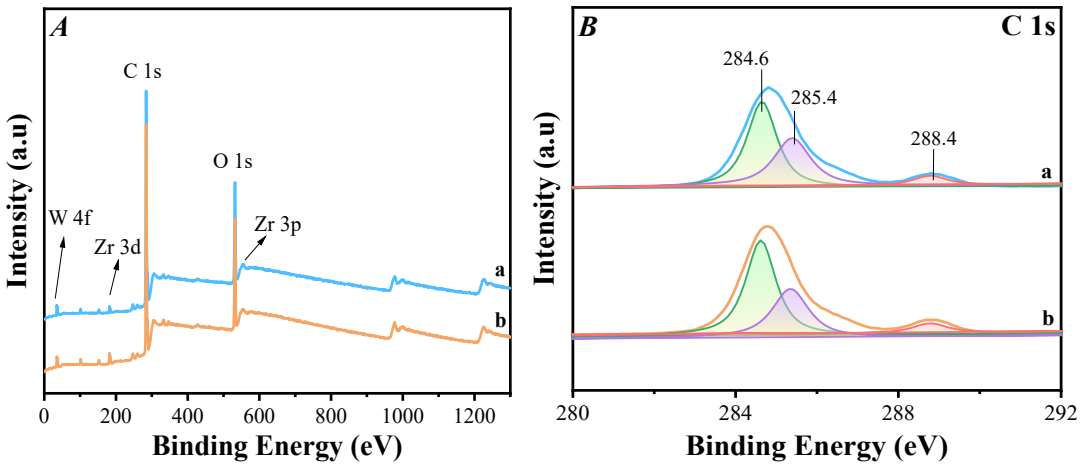

Figure S2. XPS survey scan (A) and high resolution XPS spectra for C 1s (B) of fresh (a) and recycled (b) Zr-FDCA-15HPWO after five runs.

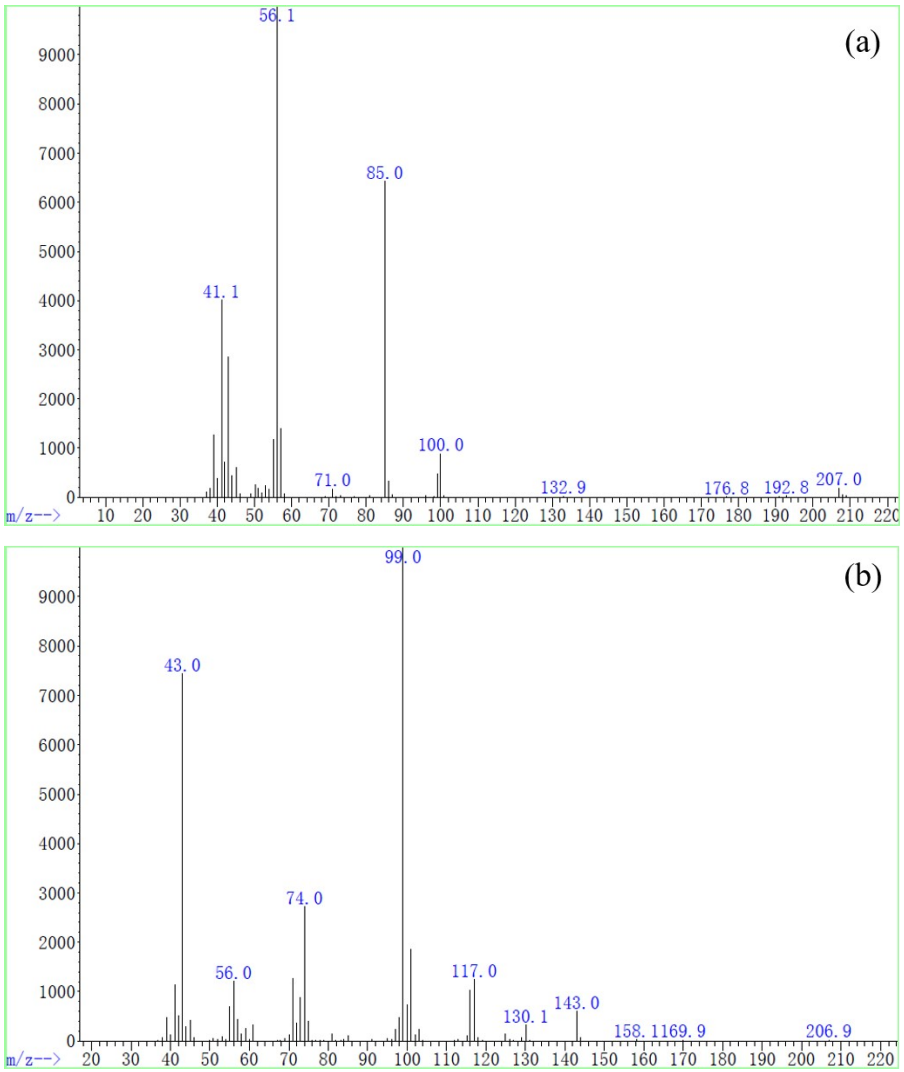

Figure S3. GC-MS spectra of GVL (a) and IPL (b) in 2-propanol.

2. Supplementary Tables

Table S1. Pore properties of various catalysts

Entry	Catalysts	S_{BET} [a] (m^2/g)	V_{pore} [b] (cm^3/g)	D_{pore} [c] (nm)
1	HPWO	7.48	0.019	7.85
2	Zr-FDCA-15HPWO	6.82	0.012	6.71
3	Zr-FDCA-15HPWO [d]	2.18	0.004	6.99

[a] BET surface area was obtained from N_2 adsorption isotherm; [b] volume of pores was estimated from BJH adsorption cumulative volume of pores; [c] average pore size was estimated from the adsorption; [d] recycled Zr-FDCA-15HPWO after five runs.

Table S2. BA and LA properties of fresh and recycled Zr-FDCA-15HPWO

Entry	Temperature (°C)	Catalysts	C_{BA} [a] (μmol/g)	C_{LA} [a] (μmol/g)	Total [b] (μmol/g)
1	200	fresh	7.55	55.02	62.57
		recycled	6.09	39.45	45.54
2	350	fresh	5.13	34.07	39.21
		recycled	3.54	21.78	25.32

[a] BA and LA were determined by Py-FTIR; [b] the sum of C_{BA} and C_{LA}.