Supplementary Information (SI) for RSC Advances.
This journal is ©The Royal Society of Chemistry 2026

Supporting Information

Efficient hydrogenation of furfural to furfuryl alcohol by recoverable copper tailings catalyst

Lele Shang,[a, b, d] Weijun Dai,[c] Xiaolong Hao,[c] Dongbao Guo,[a, b, d] Xiao Li,[a, d] Yongjie Niu,[a, b, d] Yalong Yi,[a, b, d] Hao Wang,[a, d] Xiaobo Pan,*[, c] Shuang Dai*[, a, b]

[a]MNR Key Laboratory of Strategic Mineral Resources of the Upper Yellow River, School of Earth Sciences, Lanzhou University, Lanzhou 730000, China.

[b]MOE Key Laboratory of Westemn China's Enuironmental Systems, College of Earth and Environmental Sciences, Lanzhou University, Lanzhou 730000, China.

[c]College of Chemistry and Chemical Engineering, Lanzhou University, Lanzhou 730000, China.

[d]Lanzhou Mineral Exploration Institute of Gansu Nonferrous Metal Geological Exploration Bureau, Lanzhou 730000, China.

*Corresponding author. E-mail addresses: boxb@lzu.edu.cn; daisher@lzu.edu.cn

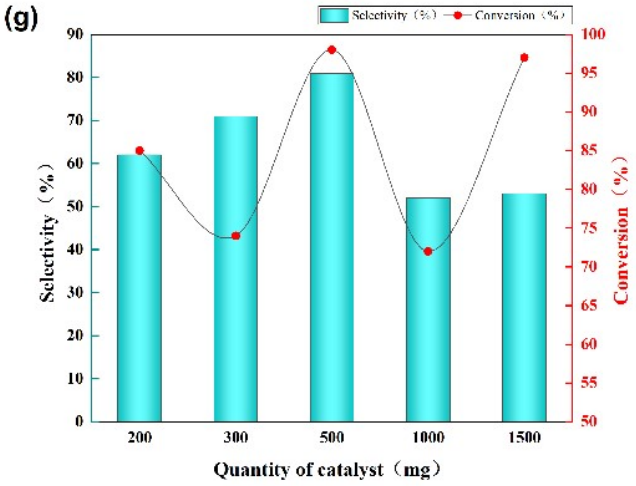

Fig. S1. Screening of the amount of CTC

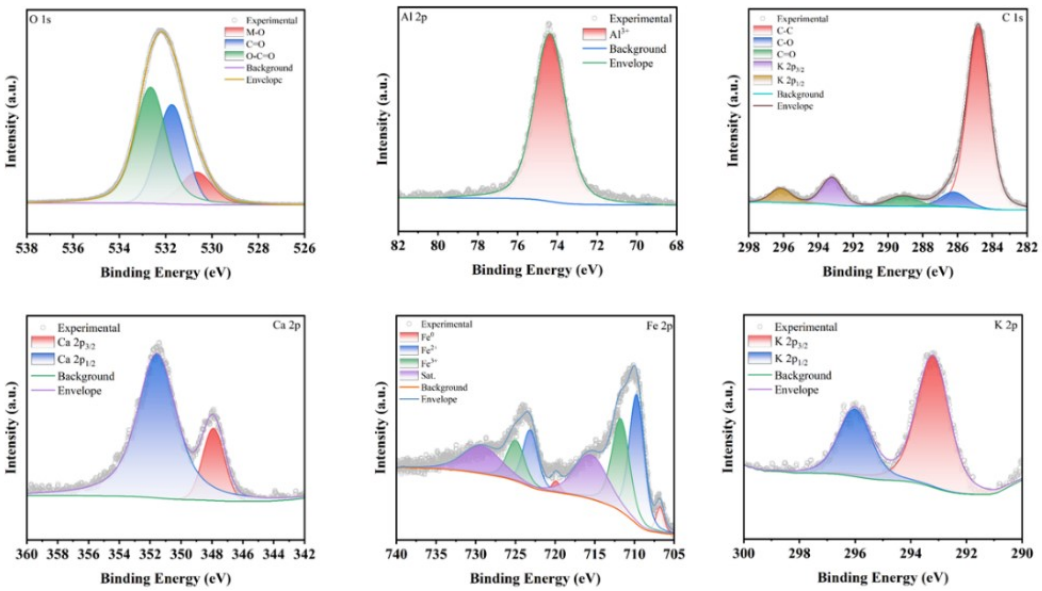

Fig. S2. High-resolution X-ray photoelectron spectroscopy spectra of the O1s, Al 2p, C 1s, Ca 2p, Fe 2p, and K 2p peaks for the CTC.

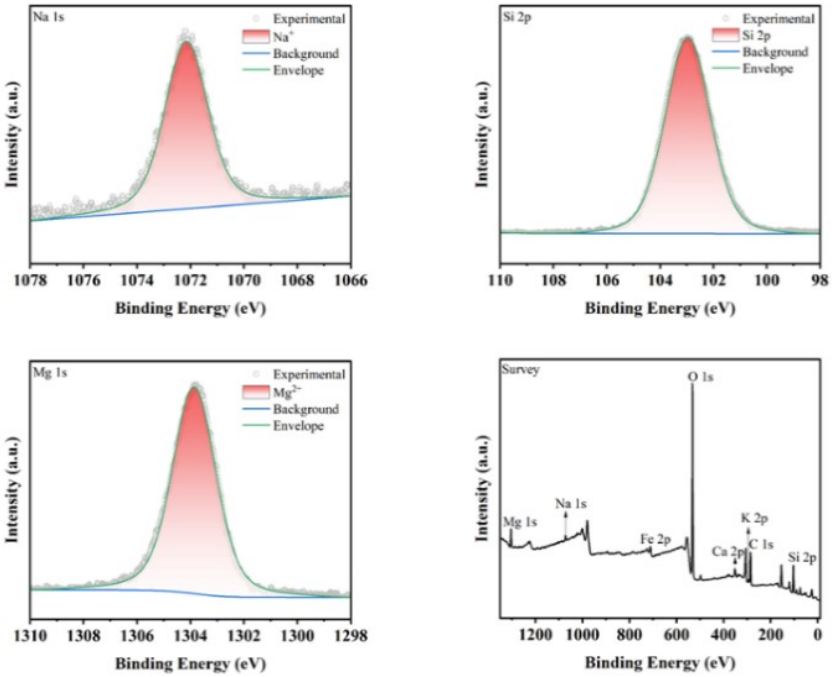

Fig. S3. High-resolution X-ray photoelectron spectroscopy spectra of the Na 1s, Si 2p, Mg 1s and survey spectrum for the CTC.

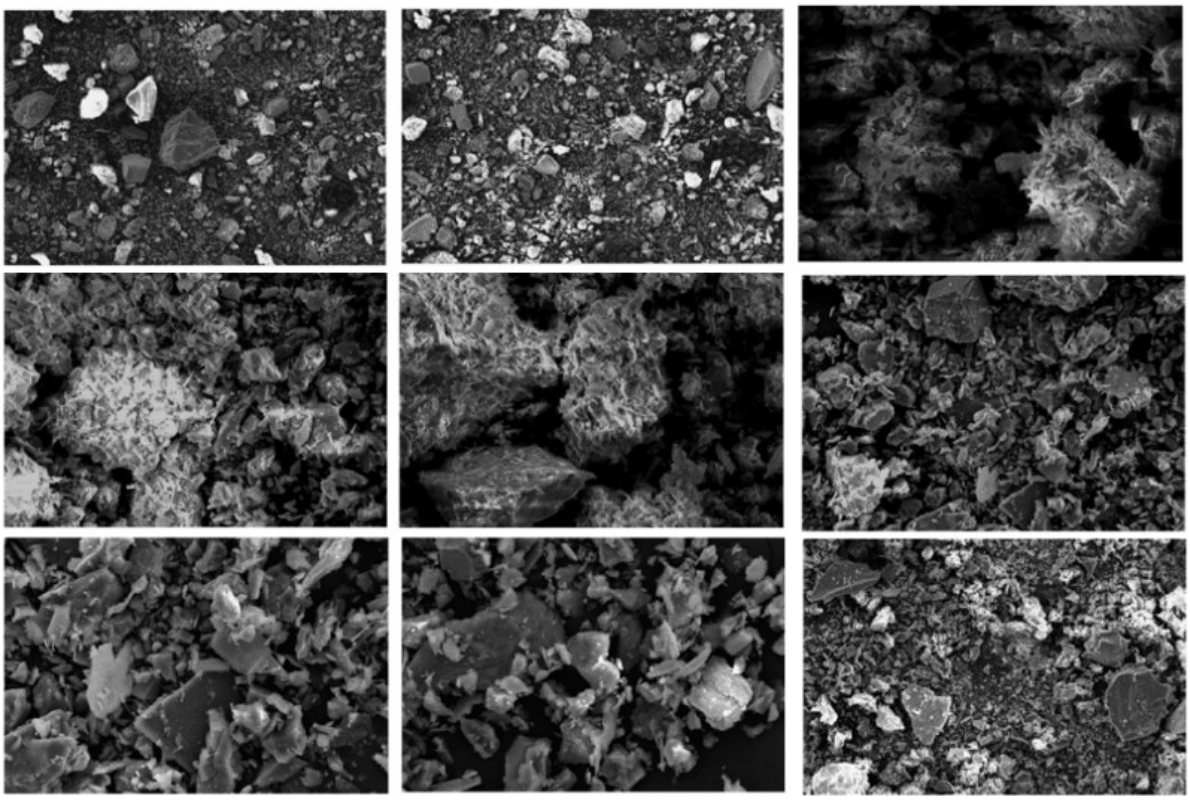

Fig. S4. SEM image of CTC

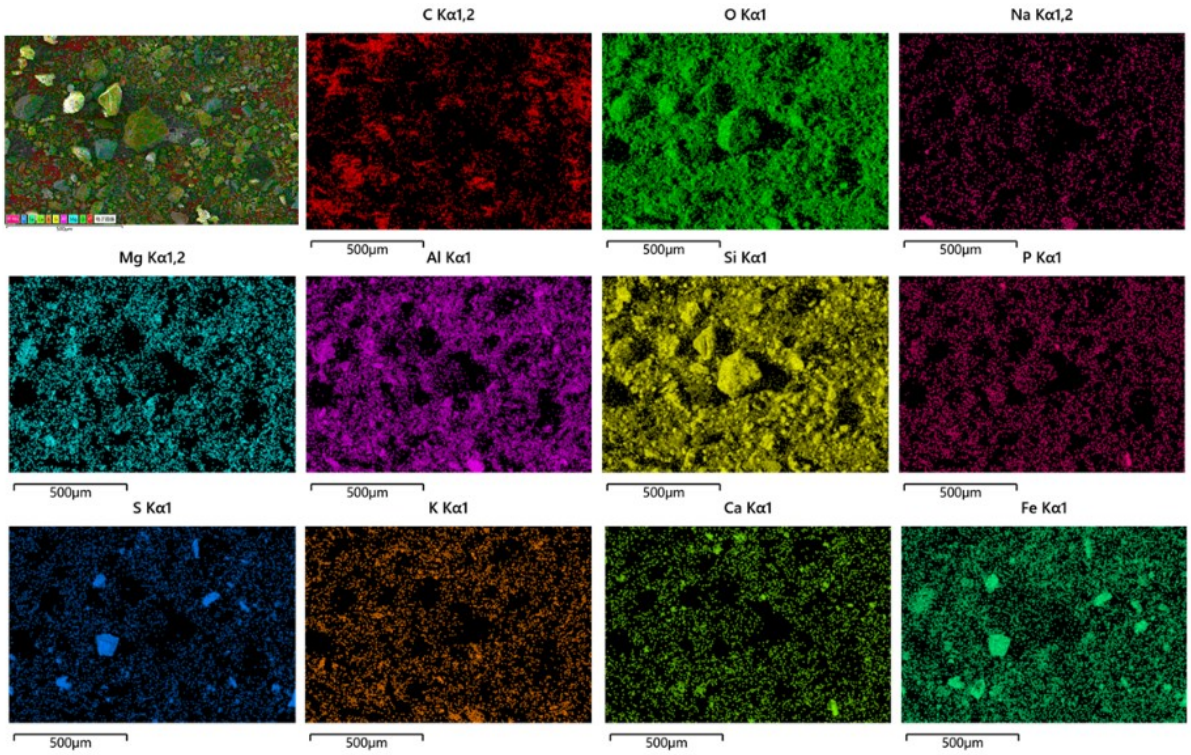

Fig. S5. EDS elemental mapping of CTC

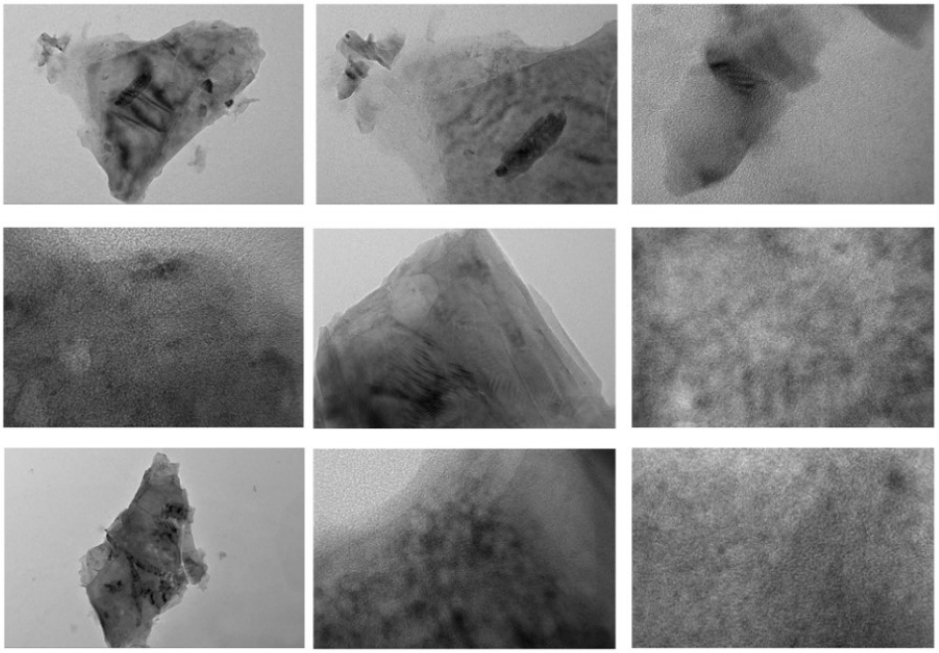

Fig. S6. TEM image of CTC

H_2-TPR(TPD) Specific Test: A 100 mg aliquot of the sample was weighed and loaded into a quartz reaction tube. Dry and pretreat by programmed heating from room temperature to 500 °C at a rate of 10 °C/min. Purge with a helium flow (30-50 mL/min) for 1 hour, cool to 50 °C, then saturate with a 10% H_2/Ar mixed gas (30-50 mL/min) for 1 h. Switch to an argon flow (30-50 mL/min) and purge for 1 hour to remove weakly physically adsorbed H_2 from the surface. Finally, desorb *via* heating to 800 °C at a rate of 10°C/min under an argon atmosphere, and detect the desorbed gas using a TCD.

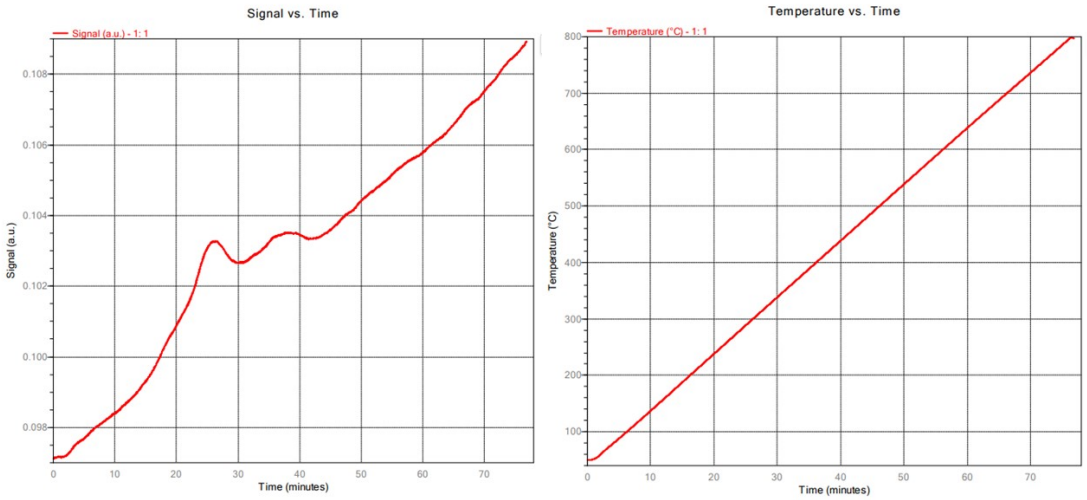

Fig. S7. TPR (H_2-TPR) curves of 4% Co/CTC

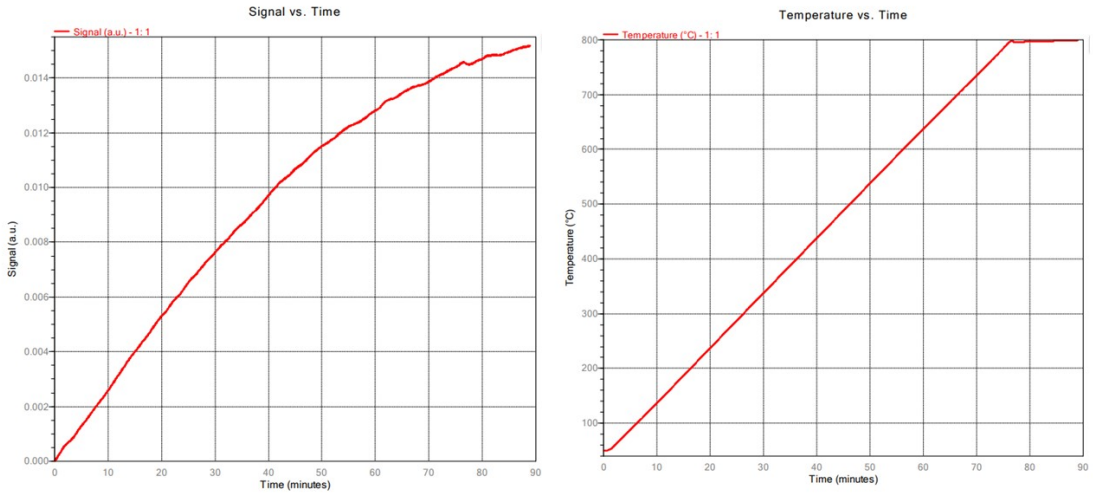

Fig. S8. TPD (H_2-TPD) curves of 4% Co/CTC

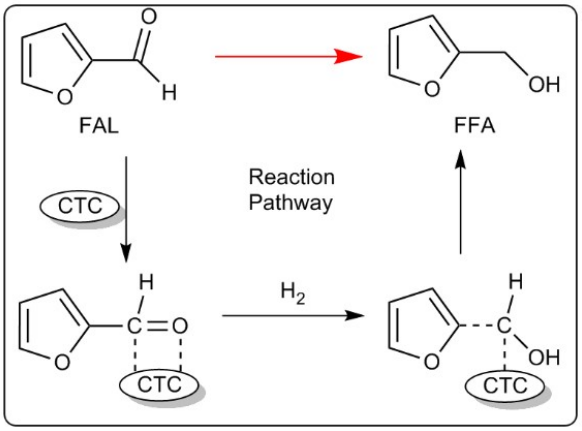

Fig. S9. The possible reaction mechanism for hydrogenolysis of FAL to FFA over the CTC.

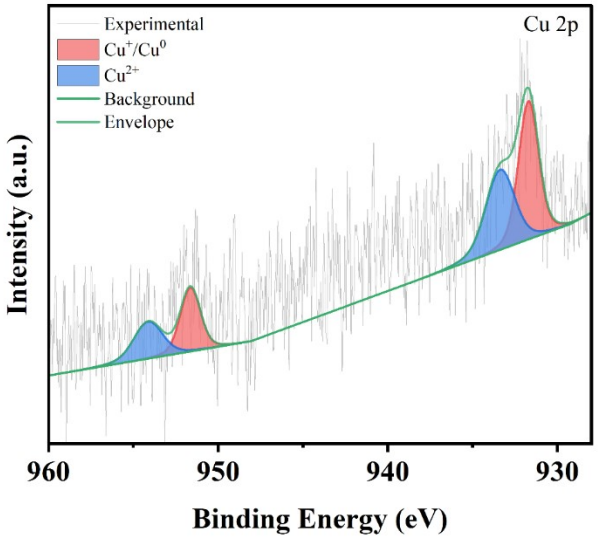

Fig. S10. XPS spectra in the Cu 2p region of the CTC.

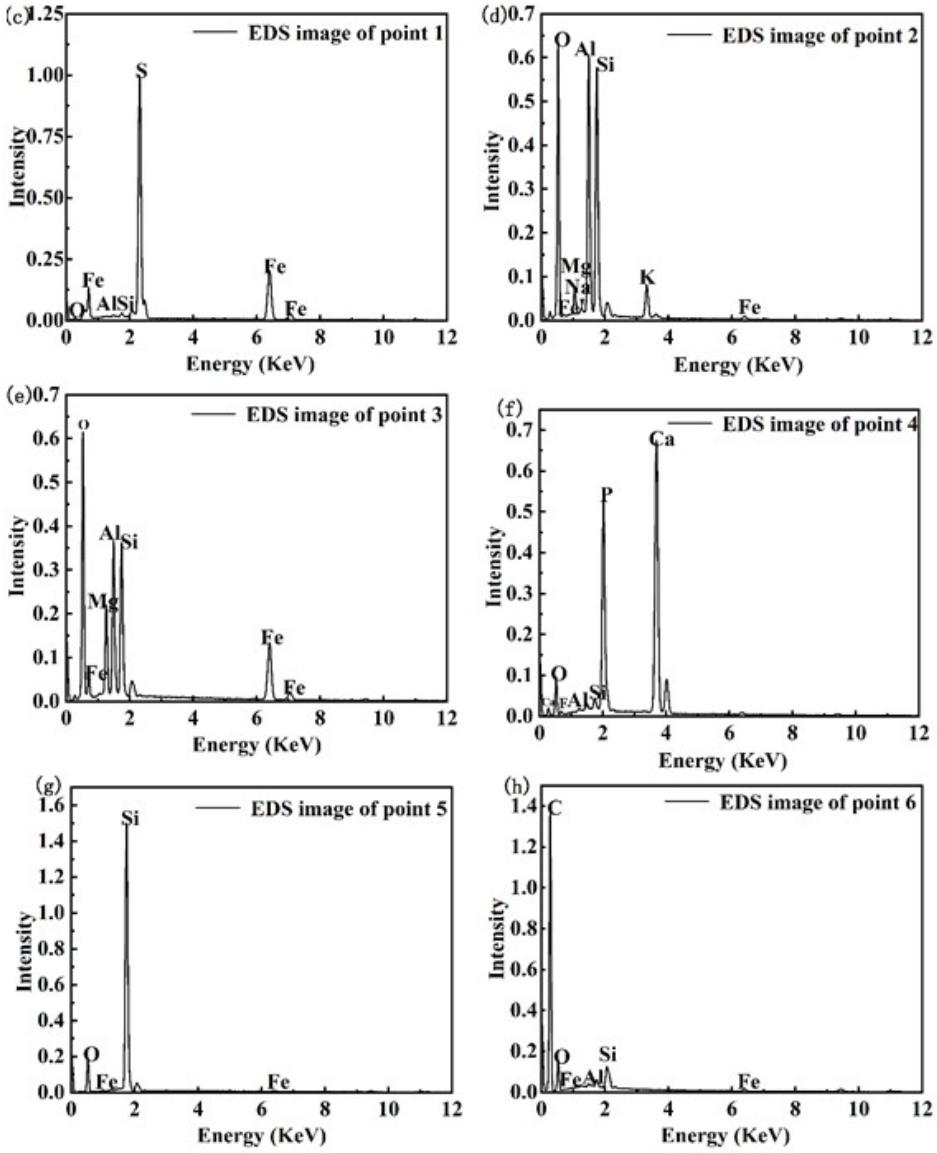

Fig. S11. EDS point analysis of the CTC at six representative positions.

Table S1. Effect of gas on the catalytic reaction over CTC.

Entry	Gas	Conv. (%)	Sel. (%)		
			FFA	THFA	Others
1	H_2	98	80	0	20
2	N_2	2	0	0	100

Reaction conditions: 1 mmol furfural, 500 mg catalyst, 200 °C, 3.0 MPa gas, 72 h, 10 mL IPA.