

Supporting information

Catalytic Synthesis of Renewable 2-Methylfuran from Furfural

Yuanyuan Han ^a, Xing Zhang ^b, Wei Wang ^a, Shaobo Guo ^a, Xiaohui Ji ^{a, *}, Guangyi Li ^{b, *}

^a Shaanxi Key Laboratory of Catalysis, School of Chemical & Environment Science, Shaanxi

University of Technology, Hanzhong, Shaanxi 723001, P. R. China;

^b CAS Key Laboratory of Science and Technology on Applied Catalysis, Dalian Institute of
Chemical Physics, Chinese Academy of Sciences, Dalian 116023, China

* E-mail: jxiaohui@snut.edu.cn (X. Ji); lgy2010@dicp.ac.cn (G. Li)

Table S1. Comparison of catalytic performance of Co/CoO_x catalyst and other reported catalysts in furfural selective hydrodeoxygenation.

Entry	Catalyst	T(°C)	2-MF yield (%)	Time (h)	Furfural to catalyst ratio	Ref.
1	Cu-Ni/TiO ₂	200	84.5	0.87 g _{FFR} h ⁻¹ g _{catalyst} ⁻¹		1
2	Co/MoO ₃	250	93	0.10 g _{FFR} h ⁻¹ g _{catalyst} ⁻¹		2
3	4wt %Pd-1wt %Ru/TiO ₂	Room temperature	51.5	2	10:1	3
4	Ru/C	180	76	10	2.4:1	4
5	Ir/C	220	95	5	10:1	5

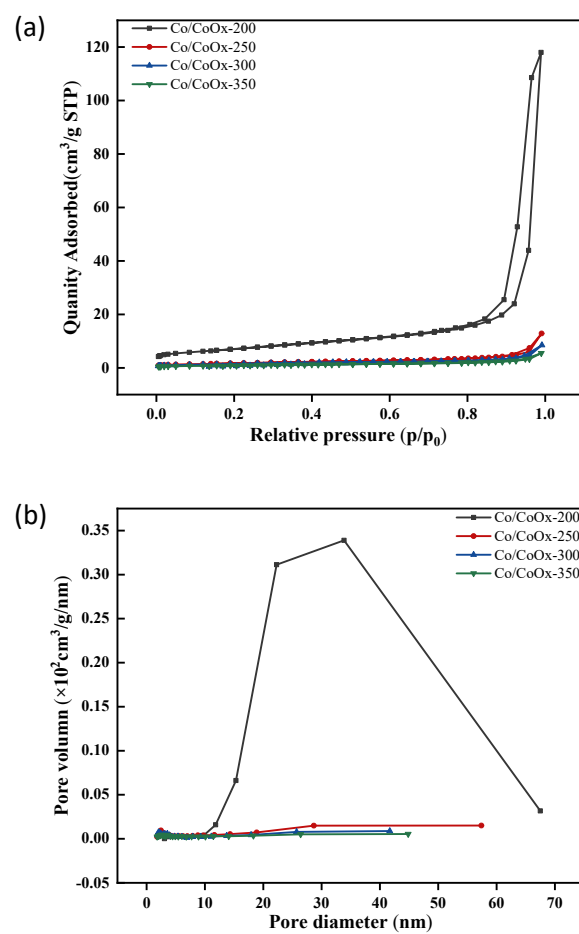


Fig. S1. Textural properties of CoO/CoO_x at different reduction temperatures.

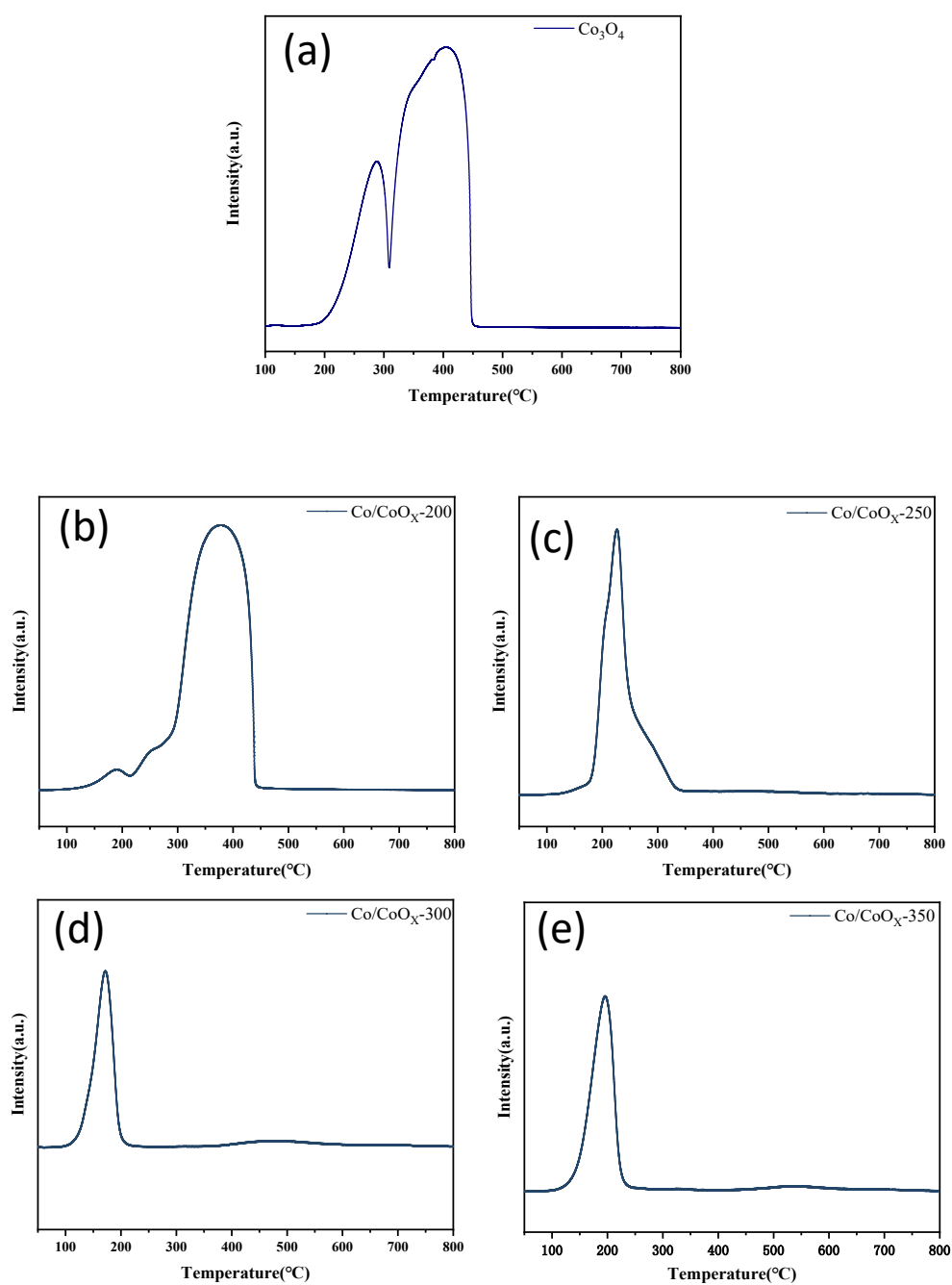


Fig. S2. (a) H₂-TPR spectra of Co₃O₄ catalysts; (b-e) H₂-TPR spectra of Co/CoO_x catalysts at different reduction temperatures.

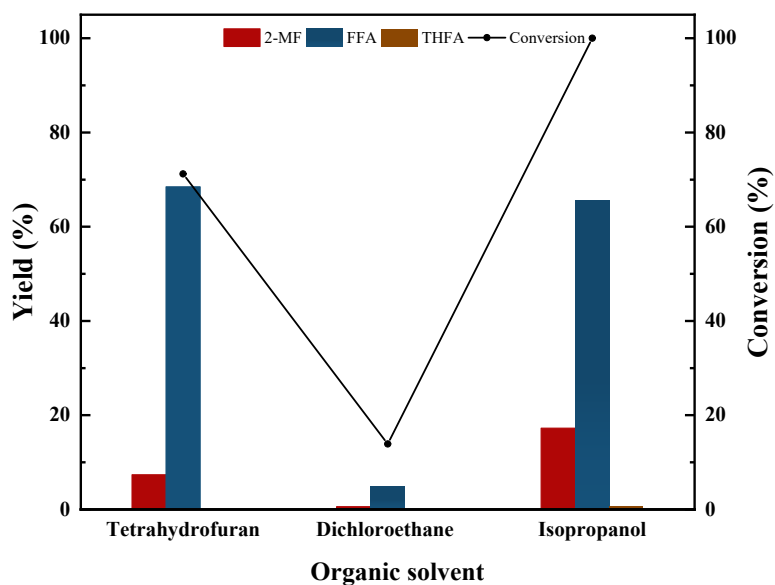


Fig. S3. Effect of organic solvent on conversion and yield of furfural selective hydrodeoxygenation with Co/CoO_x catalysts.

Reaction conditions: furfural 1 g, organic solvent 20 mL, catalyst 100 mg, temperature 130 °C, stirring speed 700 rpm, H₂ pressure 2 MPa, time 2 h. 2-MF: 2-methylfuran, FFA: furfuryl alcohol, THFA: tetrahydrofurfuryl alcohol.

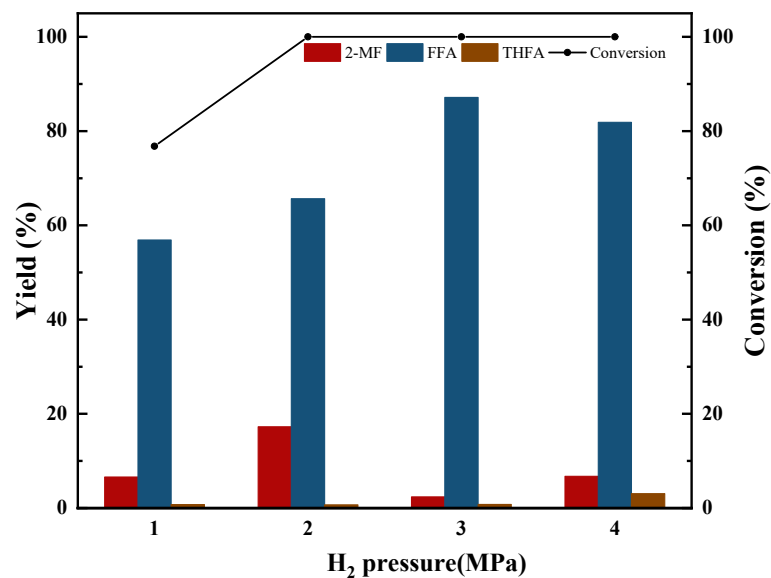


Fig. S4. Effect of H₂ pressure on the conversion and yield of furfural selective hydrodeoxygenation with Co/CoO_x-300 catalyst.

Reaction conditions: furfural 1 g, isopropyl alcohol 20 mL, catalyst 100 mg, temperature 130 °C, stirring speed 700 rpm, time 2 h. 2-MF: 2-methylfuran, FFA: furfuryl alcohol, THFA: tetrahydrofurfuryl alcohol.

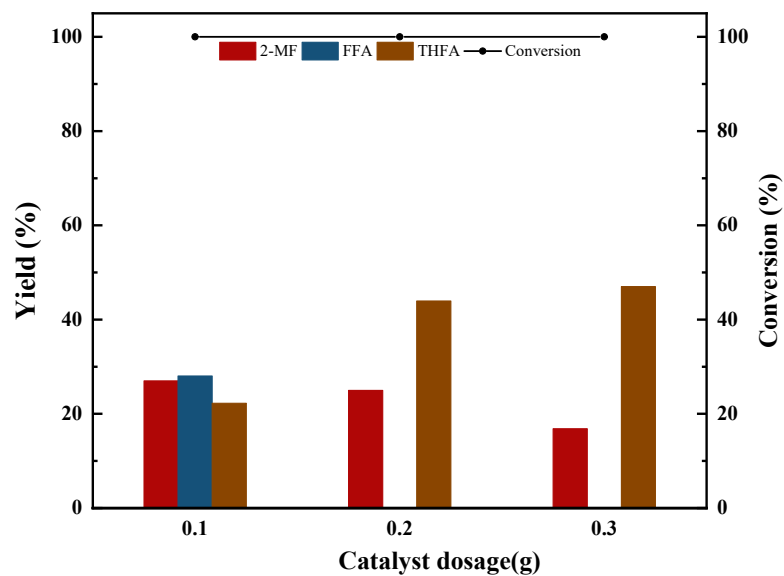


Fig. S5. Effect of Co/CoO_x-300 catalyst dosage on the conversion and yield of furfural selective hydrodeoxygenation.

Reaction conditions: furfural 1 g, isopropyl alcohol 20 mL, temperature 130 °C, stirring speed 700 rpm, H₂ pressure 2 MPa, time 2 h. 2-MF: 2-methylfuran, FFA: furfuryl alcohol, THFA: tetrahydrofurfuryl alcohol.

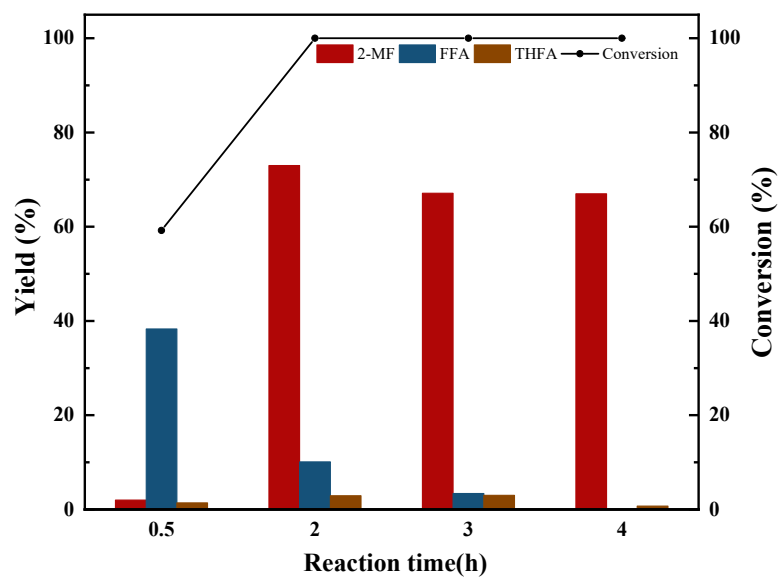


Fig. S6. Effect of reaction time of Co/CoO_x-300 catalyst on the conversion and yield of furfural selective hydrodeoxygenation.

Reaction conditions: furfural 1 g, isopropyl alcohol 40 mL, catalyst 200 mg, stabilizer dosage 0.75ppm, stirring speed 700 rpm, H₂ pressure 2 MPa, time 2 h. 2-MF: 2-methylfuran, FFA: furfuryl alcohol, THFA: tetrahydrofurfuryl alcohol.

Table S2 Textural properties of the fresh and used catalysts measured by BET method

Catalysts	BET surface area (m ² /g)	Total pore volume (cm ³ /g)
Fresh catalysts	5.8	0.0021
Used after three runs	2.2	0.0011

Table S3 The atomic ratio of Co atoms with fresh and used catalysts, which was calculated from the hydrogen consumption in H₂-TPR.

Catalysts	Quantity (mmol/g)	Atomic ratio
Fresh catalysts	0.875	Co ⁰ :Co ²⁺ =94.8%:5.2%
Used after three runs	0.229	Co ⁰ :Co ²⁺ =98.6%:1.2%

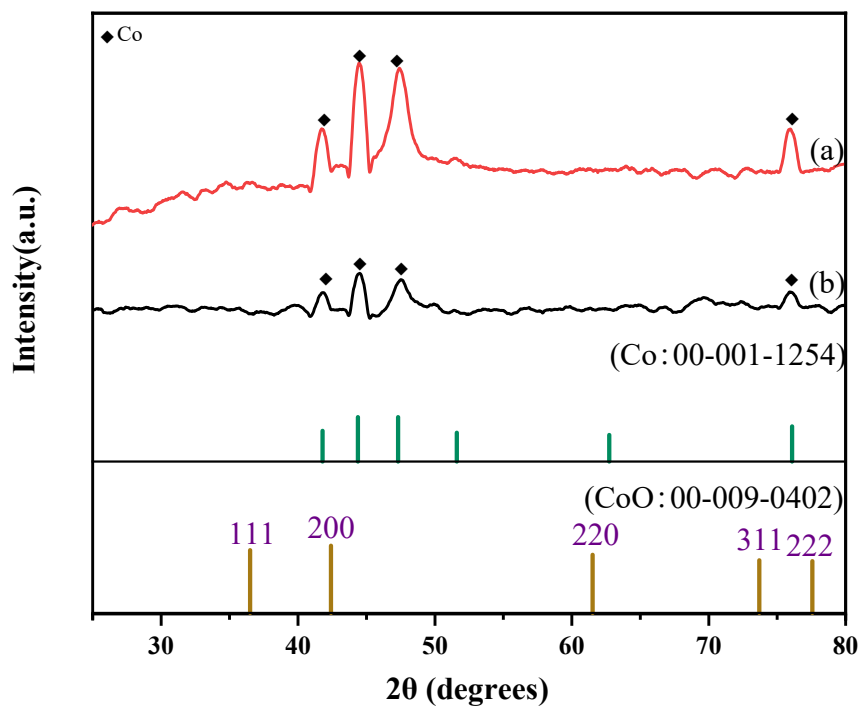


Fig .S7. XRD of fresh and used catalysts (a) fresh Co/CoO_x-300 and (b) used catalysts Co/CoO_x-300

References

- 1 A. Jaswal, P. P. Singh, A. K. Kar, T. Mondal and R. Srivastava, *Fuel Processing Technology*, 2023, 245: 107726.
- 2 Z. Lin, W. Wan, S. Yao and J. G. Chen, *Applied Catalysis B: Environmental*, 2018, 233: 160-166.
- 3 F. Ma, H. Li and J. Jiang, *Chemical Research in Chinese Universities*, 2019, 35(3): 498-503.
- 4 A. O'Driscoll, T. Curtin, W. Y. Hernández, P. Van Der Voort and J. J. Leahy, *Organic Process Research & Development*, 2016, 20(11): 1917-1929.
- 5 O. F. Aldosari, S. Iqbal, P. J. Miedziak, G. L. Brett, D. R. Jones, X. Liu, J. K. Edwards, D. J. Morgan, D. K. Knight and G. J. Hutchings, *Catalysis Science & Technology*, 2016, 6(1): 234-242.