Supporting Information

Construction of hierarchical tubular metal–organic framework composed of nanosheet arrays as photothermal catalyst through phase transformation

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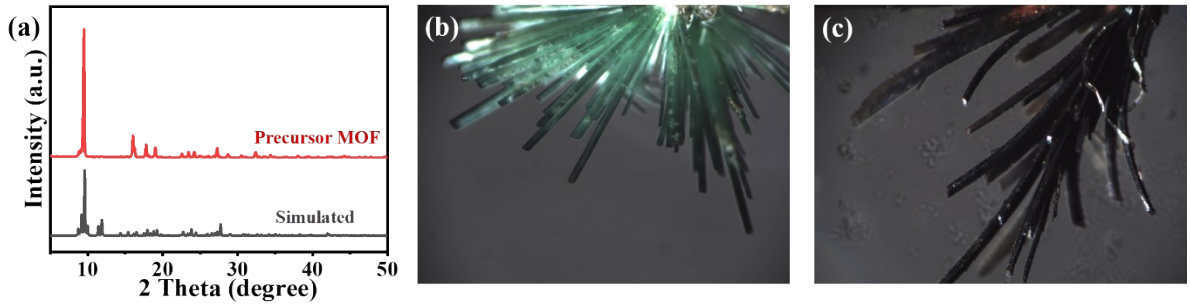


Figure S1. (a) PXRD patterns of prepared precursor MOF and the simulated precursor MOF; (b) optical microscope image of precursor MOF; (c) optical microscope image of MOF-74-HT

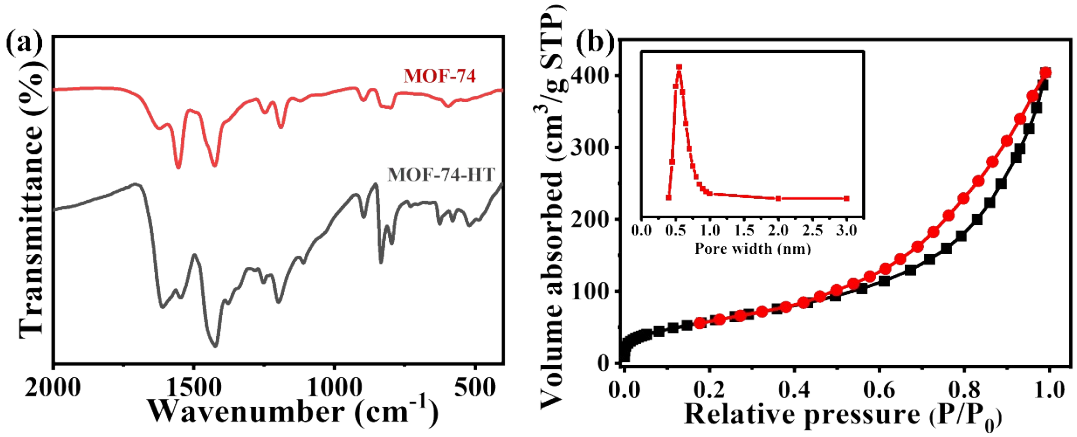


Figure S2. (a) FTIR spectrum of the MOF-74 and MOF-74-HT; (b) N_2 adsorption–desorption isotherms of MOF-74-HT.

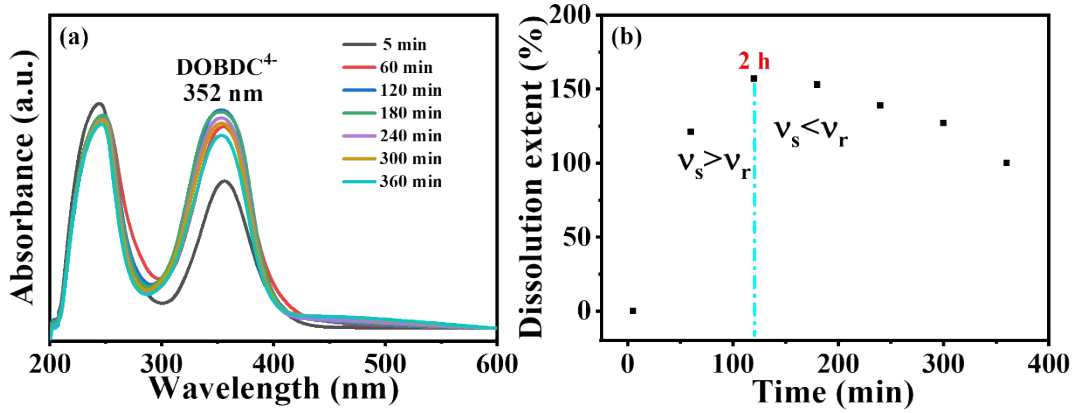


Figure S3. (a) UV-vis spectrum of precursor MOF immersed in SDBS/MeOH/H_2O for different time; (b) the dissolution extent of precursor MOF in different time.

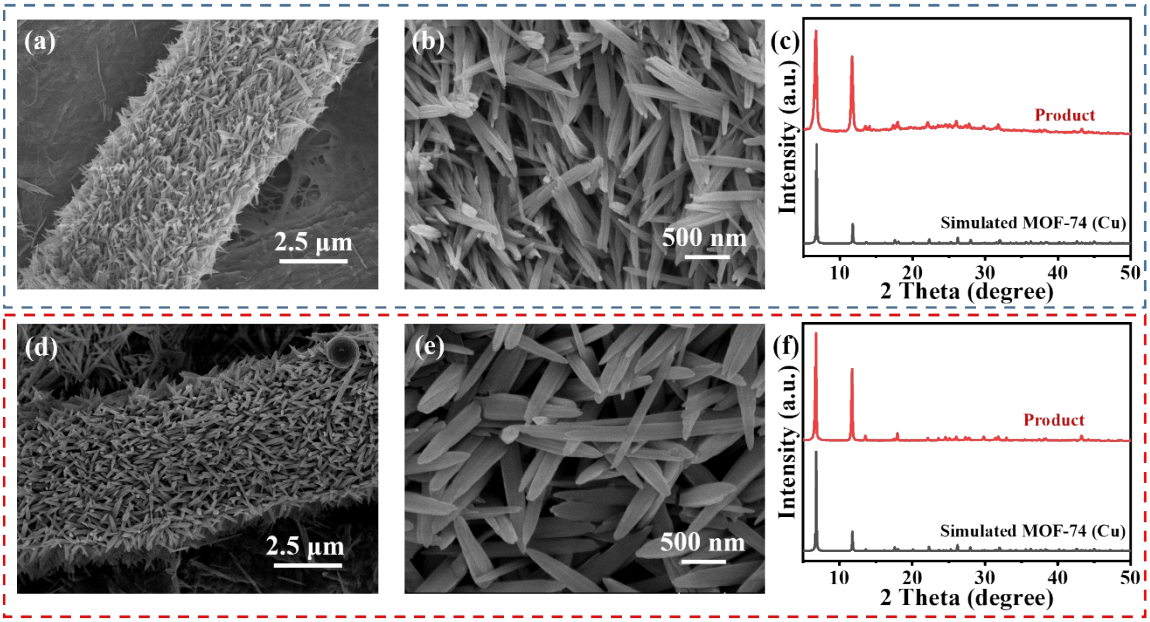


Figure S4. (a-b) SEM images of the product in MeOH; (c) PXRD patterns of the product in MeOH and simulated MOF-74 (Cu); (d-e) SEM images of the product in MeOH/H_2O; (f) PXRD patterns of the product obtained in MeOH/H_2O and simulated MOF-74 (Cu).

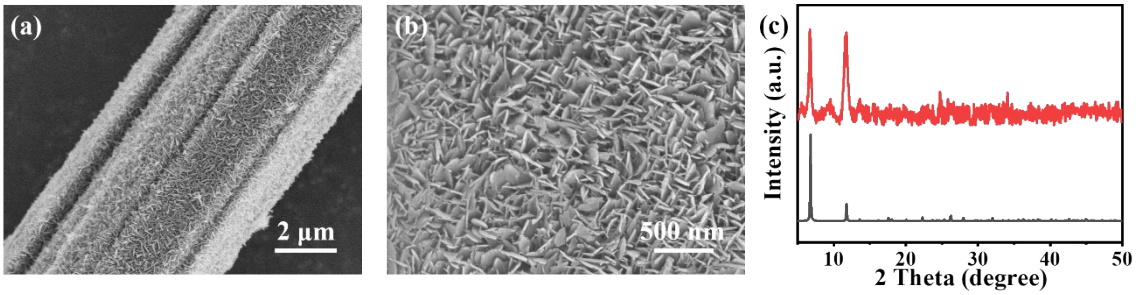


Figure S5. (a-b) SEM images of MOF-74-HT treated by ultrasonic for 30 min with different magnification; (c) PXRD pattern of MOF-74-HT treated by ultrasonic for 30 min and simulated MOF-74 (Cu).

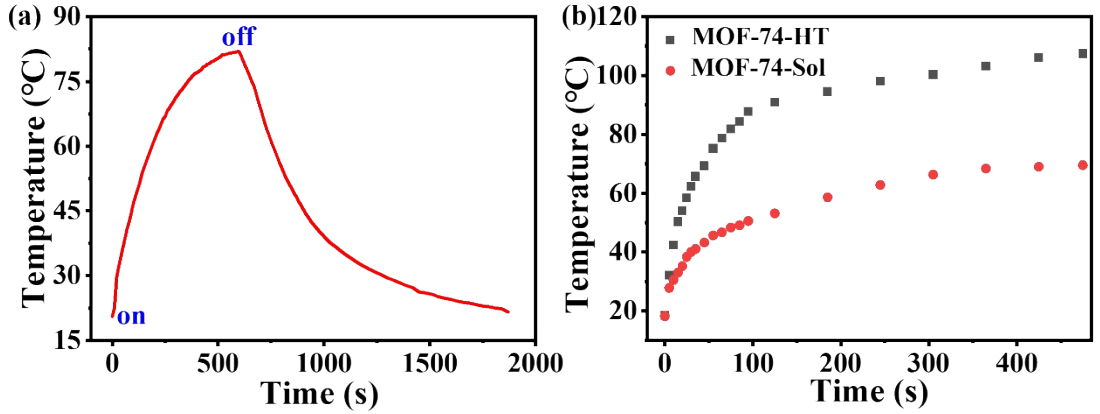


Figure S6. (a) The photothermal response of MOF-74-HT aqueous dispersion (400 μg/mL) under irradiation of 808 nm laser with 1.96 W; (b) the temperature–time curves of MOF-74-HT powder and MOF-74-Sol powder under the irradiation of Xe lamp.

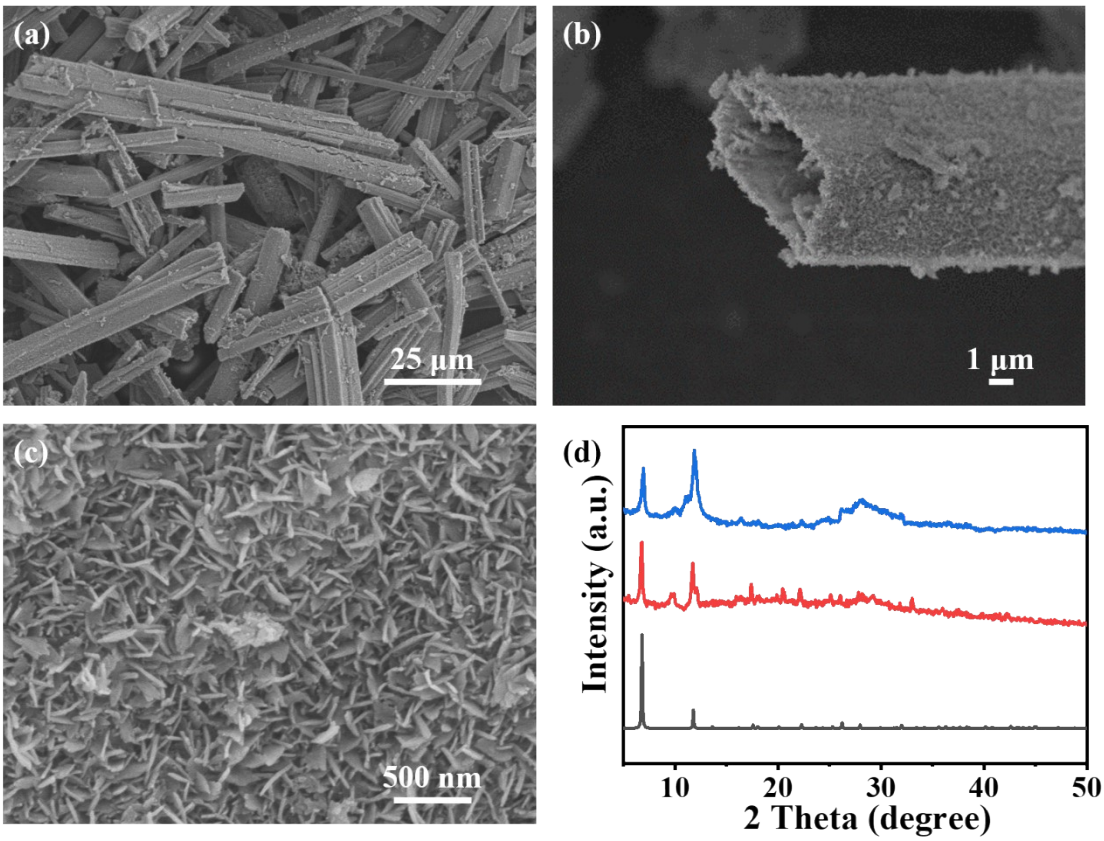


Figure S7. (a–c) SEM images of MOF-74-HT after being used as catalyst at different magnifications, (d) PXRD patterns of MOF-74-HT after reaction, before reaction and simulated MOF-74

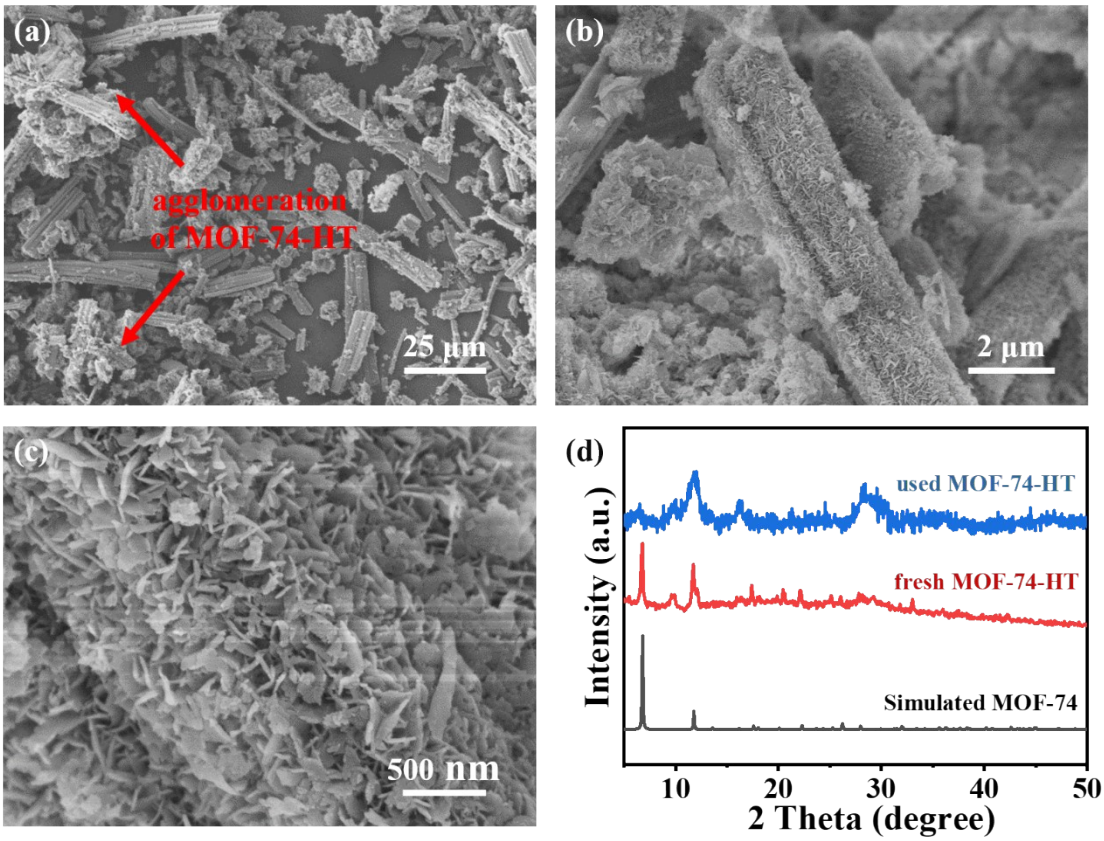


Figure S8. (a–c) SEM images of MOF-74-HT after the tenth cycles at different magnification, (d) PXRD patterns of MOF-74-HT after the tenth cycles (blue), fresh MOF-74-HT (red), and simualted MOF-74 (black).

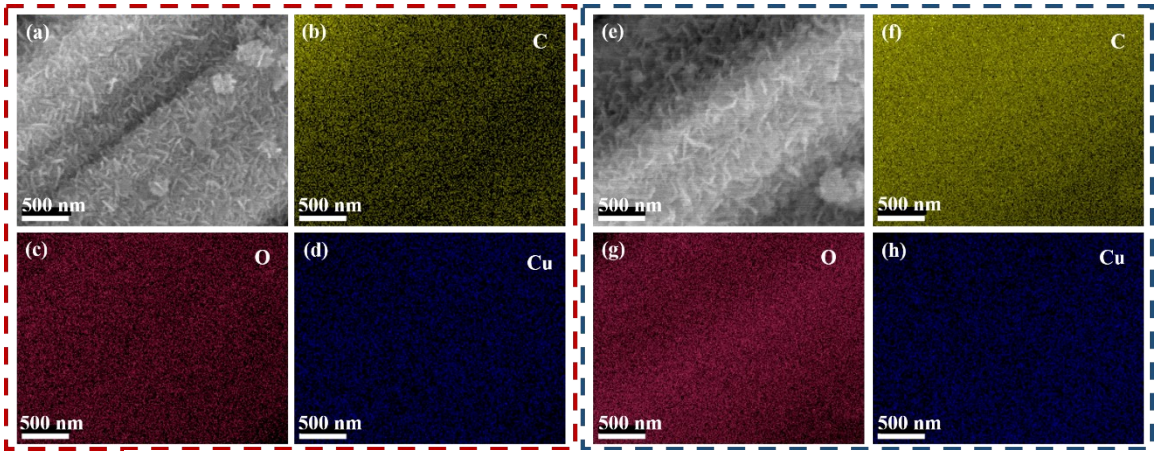


Figure S9. (a) SEM image of fresh MOF-74-HT, EDS mapping of C (b), O (c), and Cu (d) in fresh MOF-74-HT; (e) SEM image of used MOF-74-HT, EDS mapping of C (f), O (g), and Cu (h) in used MOF-74-HT

As shown in Figure S9, the element of C, O, and Cu distributed uniformly over the fresh MOF-74-HT and used MOF-74-HT, and there is no obvious difference in MOF-74-HT before and after reaction.

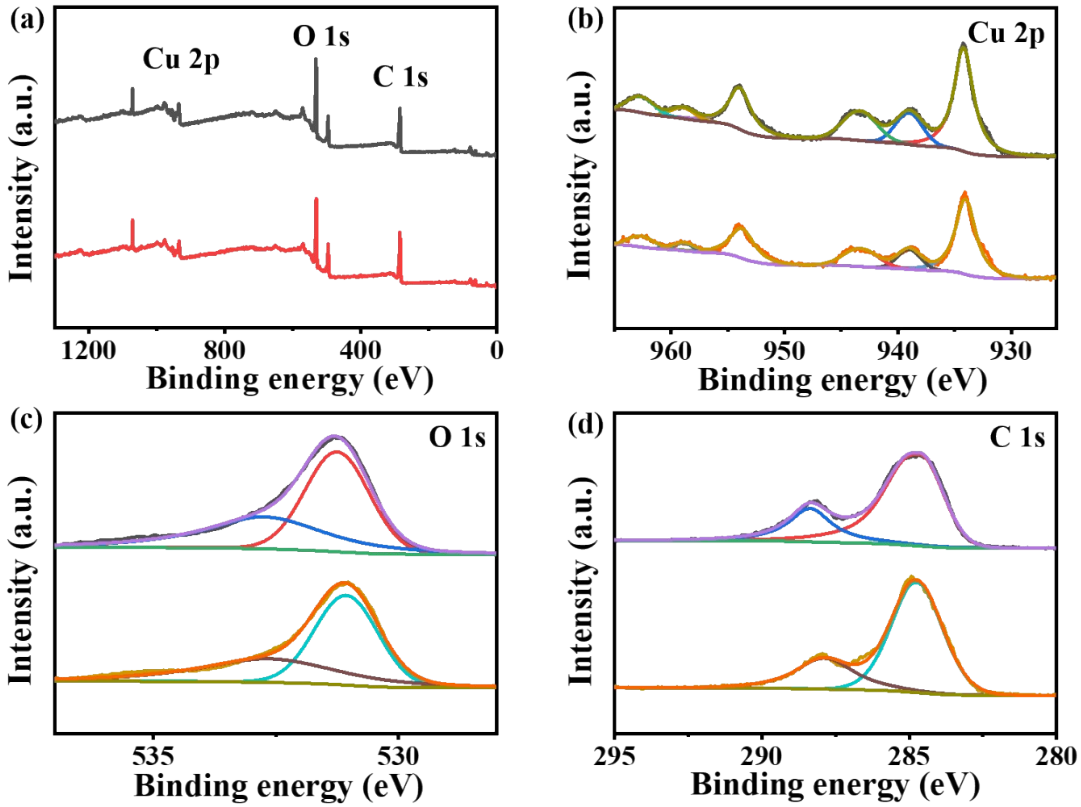
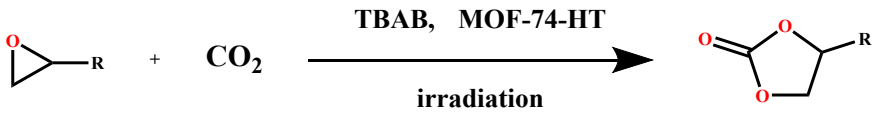
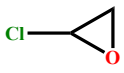
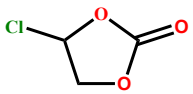
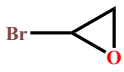
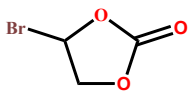
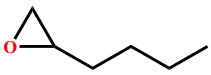
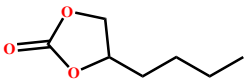
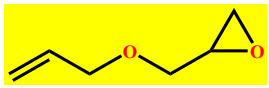
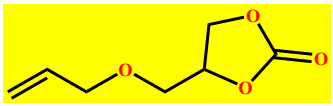
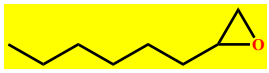
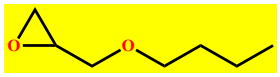
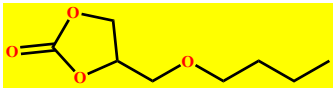


Figure S10. (a) XPS survey spectra of fresh MOF-74-HT (up) and used MOF-74-HT (down), high-resolution XPS spectra of Cu 2p (b), O 1s (c), and C 1s (d) in fresh MOF-74-HT (up) and used MOF-74-HT (down)

The XPS survey spectra confirmed the same elemental composition of MOF-74-HT before and after cycloaddition reaction, including C, O, and Cu, as shown in Figures S10a–10d. And the high-resolution XPS spectra of Cu 2p, O 1s, and C 1s also confirmed that the chemical states of elements in the used MOF-74-HT were almost identical to that of the fresh MOF-74-HT.

Table S1: The conversion of CO_2 cycloaddition reaction with various epoxides



Entry	Substrate	Products	Time (h)	Conversion (%)
1[a]			18	89.1
2[a]			18	87.3
3[b]			18	89.7
4[a]			18	86.3
5[b]			18	89.5
6[b]			18	70.8

[a]: Reaction conditions: 0.87 mmol substrate, 0.09 mmol TBAB, 15 mg catalyst, 1 bar CO_2, 150 mW/cm^2 Xe lamp irradiation.

[b]: Reaction conditions: 0.87 mmol substrate, 0.09 mmol TBAB, 15 mg catalyst, 100 µL 1,4-Dioxane, 1 bar CO_2, 150 mW/cm^2 Xe lamp irradiation.

Table S2. EA results of fresh MOF-74-HT and used MOF-74-HT

Sample (MOF-74-HT)	C%	H%	O%
fresh	31.59	1.921	29.031
used	31.93	1.643	29.654

Table S3. ICP results of fresh MOF-74-HT and used MOF-74-HT

Sample (MOF-74-HT)	Cu%
fresh	31.4
used	29.8

The EA results revealed that the contents of C, O, and H in fresh MOF-74-HT and used MOF-74-HT were similar, indicating the unchanged organic compositions of MOF-74-HT before and after catalytic reaction, as shown in Table S2. However, the ICP results proved a slight decrease in Cu content in used MOF-74-HT compared with fresh MOF-74-HT caused by the leach of Cu^{2+} from MOF-74-HT during the catalytic process, as shown in Table S3. And it might be responsible for the slight decrease of conversion of CO_2 cycloaddition with styrene oxide after 10 runs of catalytic reaction.