

## **Cu@UiO-66 衍生的 Cu<sup>+</sup>-ZrO<sub>2</sub> 界面位点用于高效催化 CO<sub>2</sub> 加氢制甲醇**

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## **Cu@UiO-66 Derived Cu<sup>+</sup>-ZrO<sub>2</sub> Interfacial Sites for Efficient CO<sub>2</sub> Hydrogenation to Methanol**

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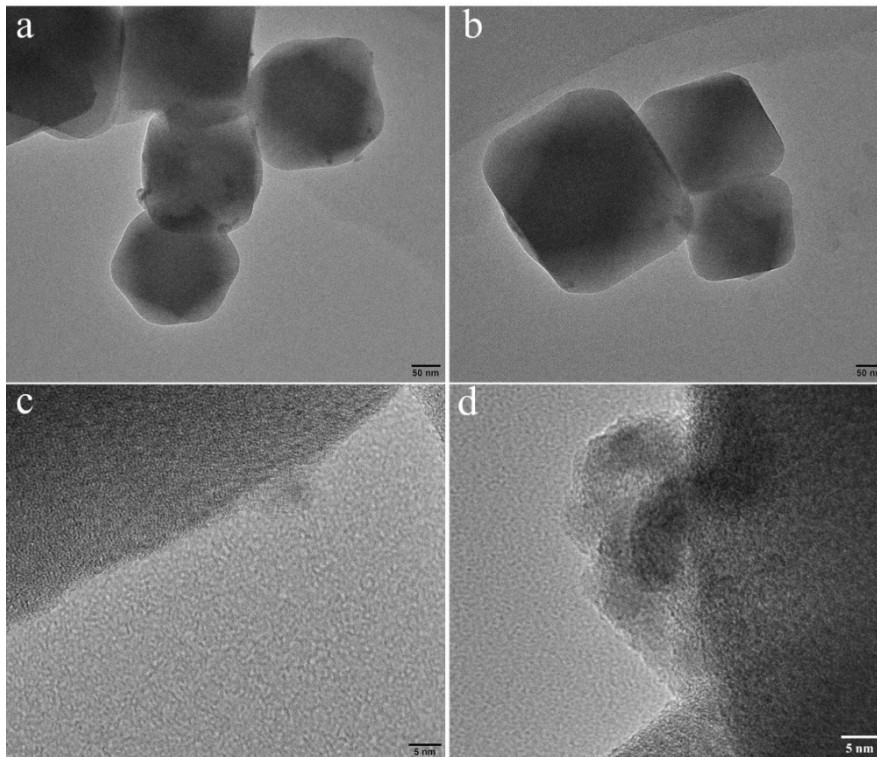


Fig. S1 TEM images of the Cu@UiO-66-0.5 precursor.

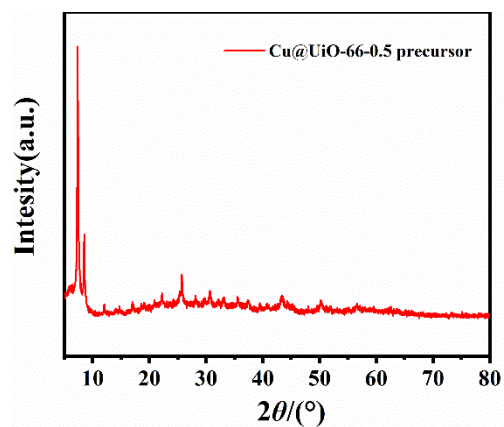


Fig. S2 XRD pattern of the Cu@UiO-66-0.5 precursor.

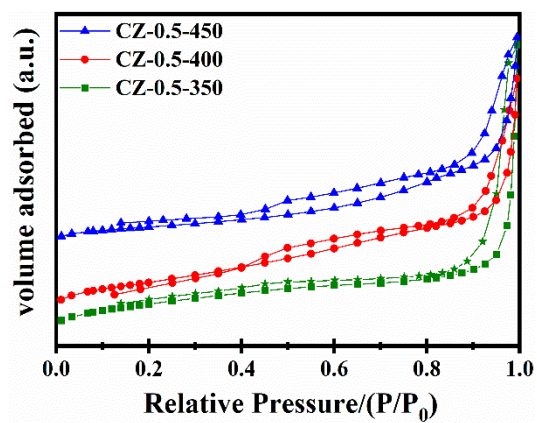
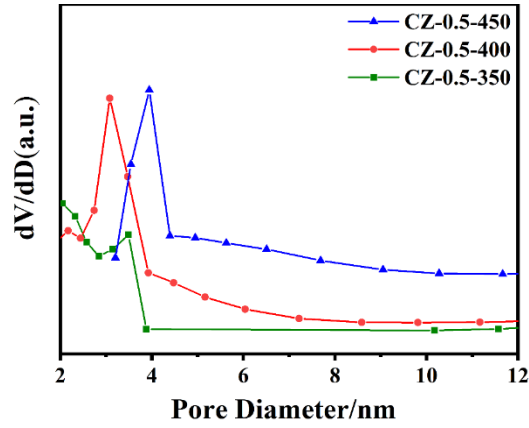


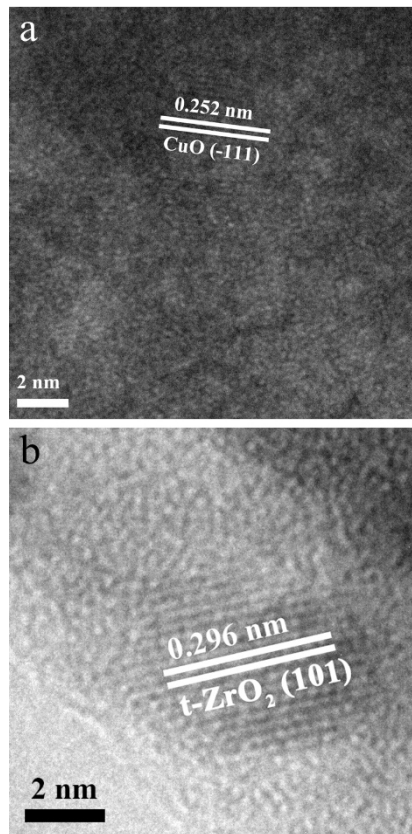
Fig. S3 N<sub>2</sub> adsorption-desorption isotherms of CZ-0.5-*T* catalysts.

**Table S1** Microstructure characteristics of catalysts prepared at different calcination temperatures.

Catalysts	BET surface area/(m <sup>2</sup> ·g <sup>-1</sup> )	Pore volume/(cm <sup>3</sup> ·g <sup>-1</sup> )	Average pore size/nm
CZ-0.5-350	49.1	0.15	13.7
CZ-0.5-400	49.4	0.12	7.9
CZ-0.5-450	32.1	0.11	9.9
UiO-66	1291.8	0.72	2.2



**Fig. S4** Pore-size distributions of CZ-0.5-*T* catalysts derived from N<sub>2</sub> desorption isotherms.



**Fig. S5** TEM images of CZ-0.5-400 after calcination and reduction.

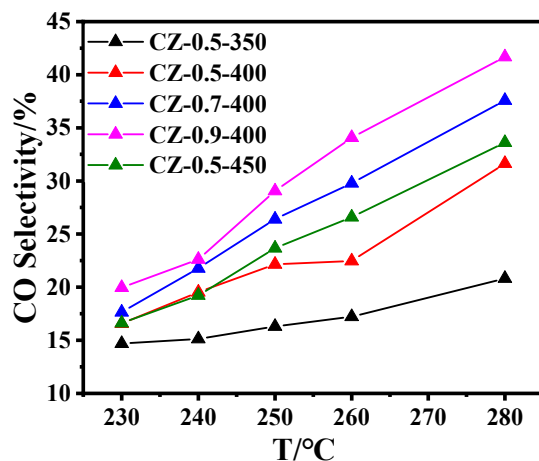


Fig. S6 CO selectivity at different temperature over CZ-x-T catalysts.

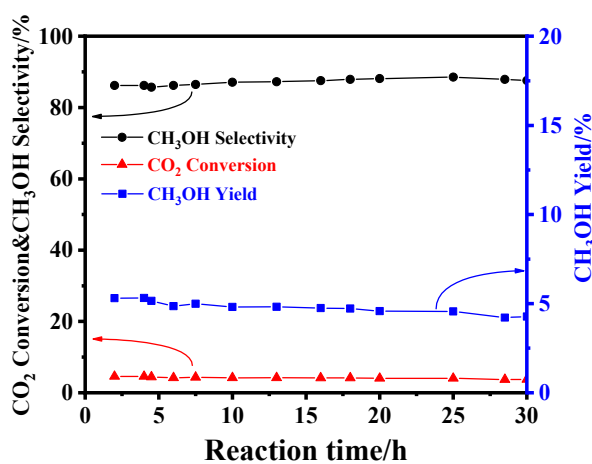


Fig. S7 TOS test of CZ-0.5-400 in the methanol synthesis from CO<sub>2</sub> hydrogenation at 260 °C.

Reaction conditions: GHSV = 21600 mL·g<sup>-1</sup>·h<sup>-1</sup>, 4.5 MPa, H<sub>2</sub>/CO<sub>2</sub> = 3.

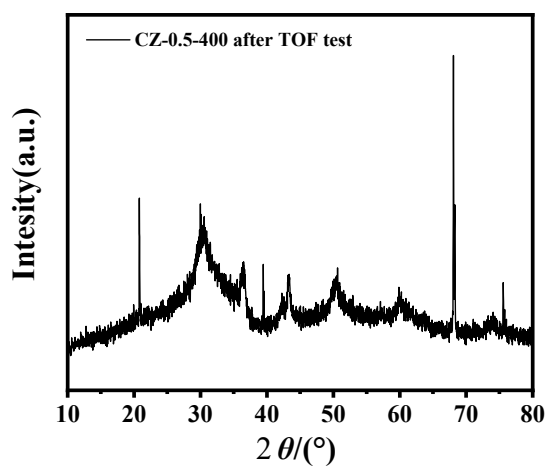


Fig. S8 XRD pattern of CZ-0.5-400 after 30 h TOF test.

Table S2<sup>a</sup> Change of Cu particle size after different reaction time.

CZ-0.5-400	Cu particle size (nm)
Reduced	5.1
Spent	8.6
After 30 h TOS	12.7

<sup>a</sup> Cu particle size is calculated from the Scheler formula according to Cu (111) lattice plane.

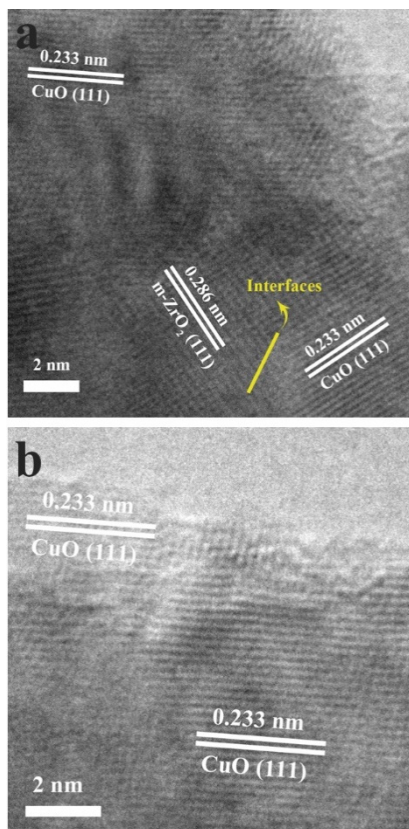


Fig. S9 TEM images of spent CZ-0.5-400.

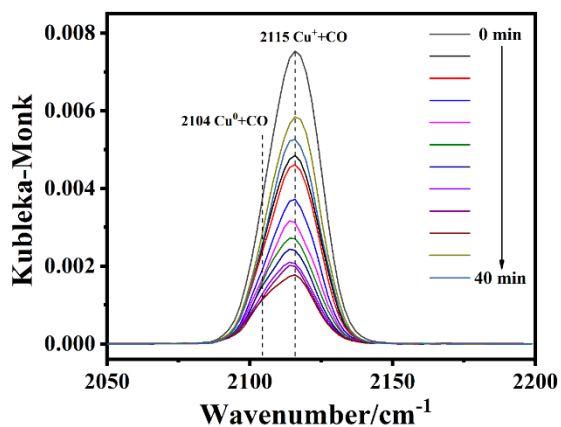


Fig. S10 *In situ* DRIFTS spectra of CO adsorption swept by Ar over reduced CZ-0.5-400.

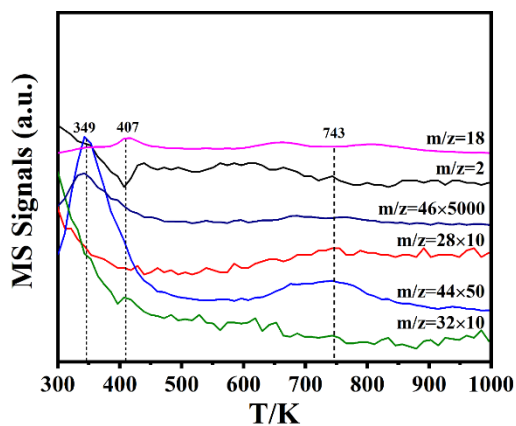


Fig. S11 TPSR-MS profiles of CO<sub>2</sub> + H<sub>2</sub> co-adsorption over CZ-0.5-400.