Supporting information

Engineering $CuZnOAl_2O_3$ catalyst for enhancing CO_2 hydrogenation to methanol

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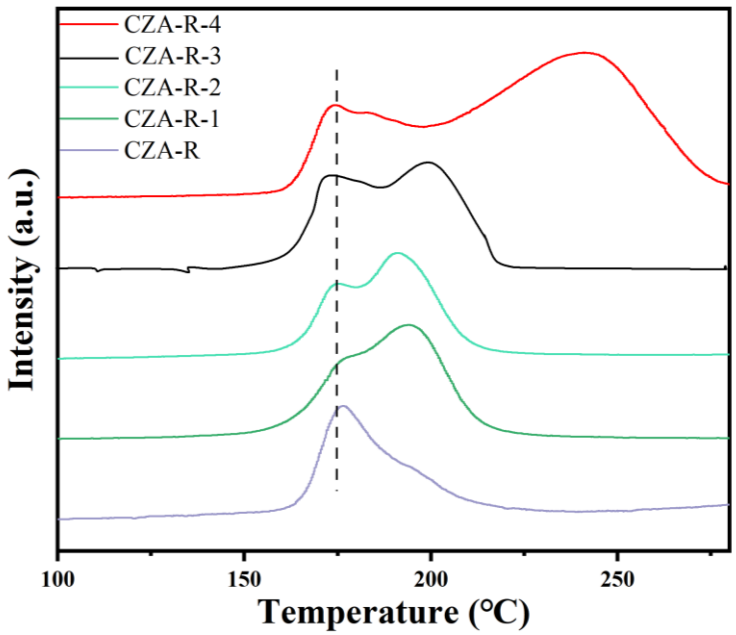
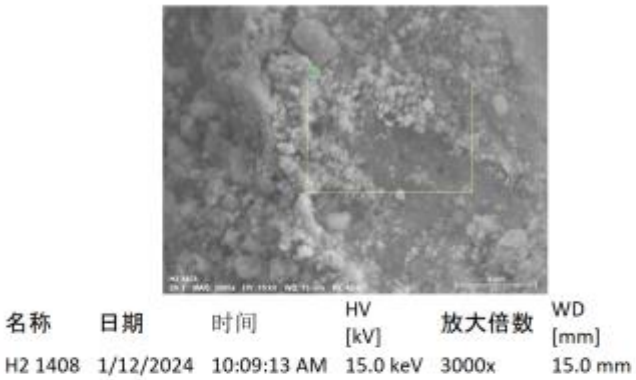


Fig. S1. H_2-TPR spectra of CZA catalysts after different pretreatments.



名称	日期	时间	HV [kV]	放大倍数	WD [mm]
H2 1408	1/12/2024	10:09:13 AM	15.0 keV	3000x	15.0 mm

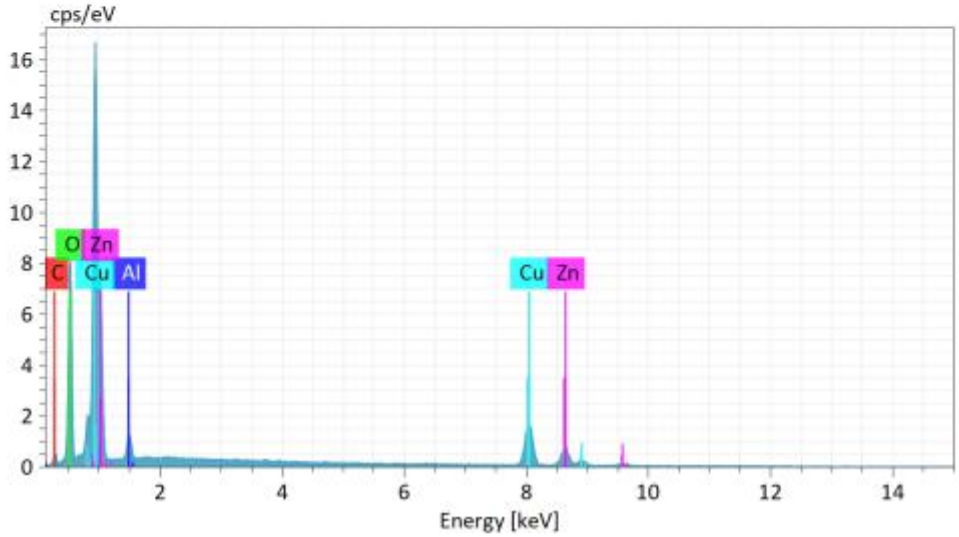


Fig. S2. EDS-mapping analysis of CZA catalyst after calcination.

Table S1. composition distribution of elements in catalyst.

Catalysts	Element	Mass percentage content (wt %)
CZAl	Cu	57.420
	Zn	32.519
	Al	10.061

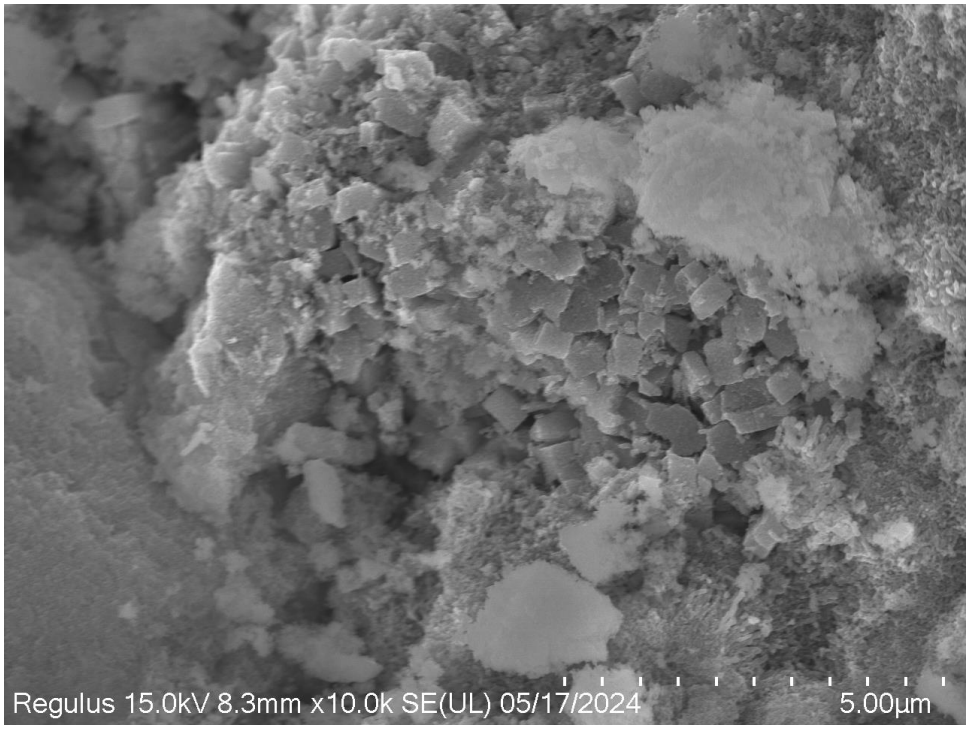


Fig. S3. The SEM image of CZA-R-1 catalyst at low power.

Table S2. Deconvolution results of Cu LMM XAES of activated CZA catalysts.

Catalyst	Cu^{+} (%)	Cu^{0} (%)	Cu^{+}/Cu^{0}
CZA-R	59.4	41.6	1.43
CZA-R-1	79.9	20.1	3.98
CZA-R-2	80.3	19.7	4.08
CZA-R-3	81.2	18.8	4.32
CZA-R-4	82.5	17.5	4.71

Table S3. CO_2 desorption capabilities of the CZA catalysts after pretreatment.

Sample	CO_2 desorption amount ($\mu mol \cdot g^{-1}$)		
	Low temperature peak	Medium temperature peak	High temperature peak
CZA-R	10.01 (101.5℃)	4.06 (205.1℃)	8.80 (367.2℃)
CZA-R-1	9.23 (101.1℃)	6.16 (200.2℃)	9.06 (368.3℃)
CZA-R-2	3.39 (101.2℃)	6.86 (196.8℃)	6.02 (369.0℃)
CZA-R-3	3.20 (100.5℃)	7.07 (192.7℃)	3.10 (370.2℃)
CZA-R-4	-	-	4.04 (368.1℃)