

Supporting information

Probing the promotional roles of cerium in structure and performance of Cu/SiO₂ catalysts for ethanol production

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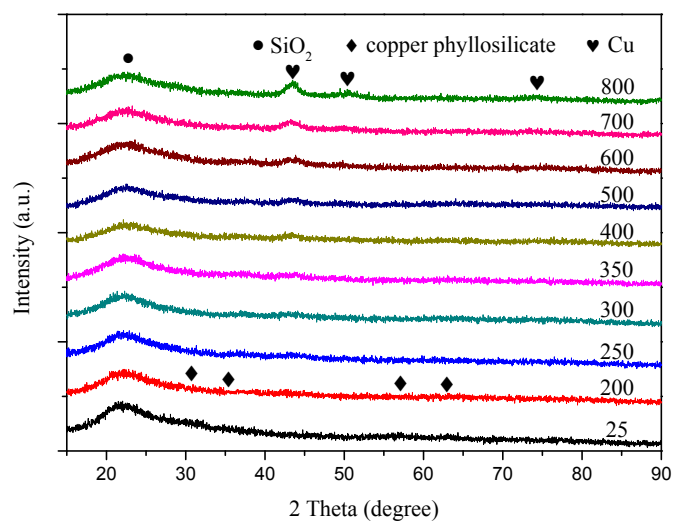


Figure S1 In situ XRD patterns after reduction at different temperatures for the calcined 2Ce-Cu/SiO₂ catalyst.

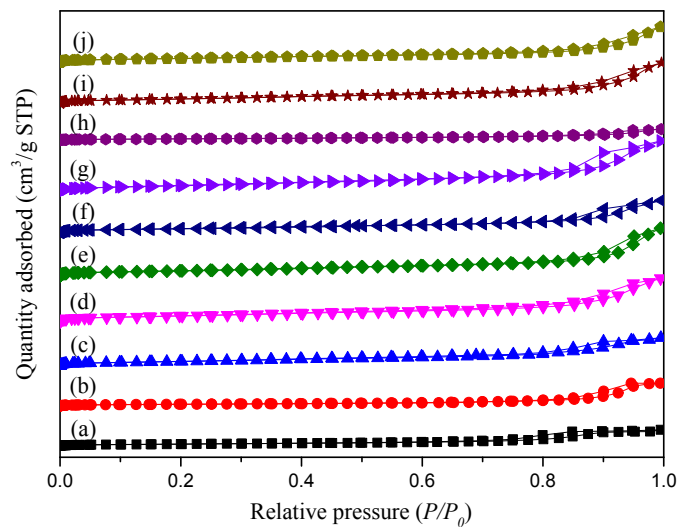


Figure S2 N₂ physisorption isotherms of (a) SiO₂, (b) 1Ce/SiO₂, (c) Cu/SiO₂, (d) 0.5Ce-Cu/SiO₂, (e) 1Ce-Cu/SiO₂, (f) 1.5Ce-Cu/SiO₂, (g) 2Ce-Cu/SiO₂, (h) Cu/CeO₂, (i) 1Ce-Cu/SiO₂-i and (j) 1Ce-Cu/SiO₂ catalysts.

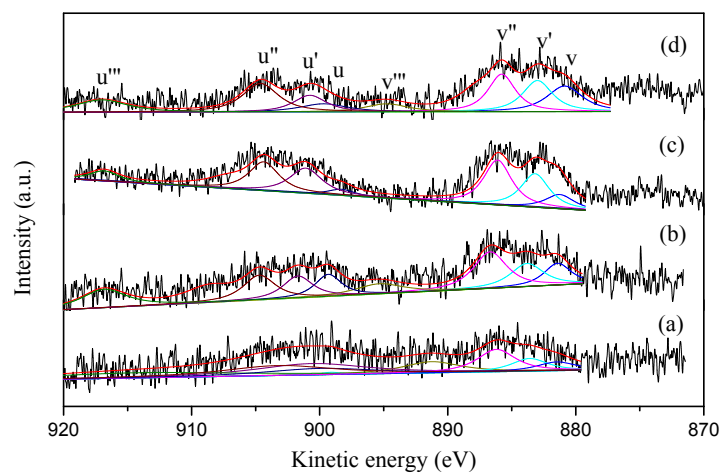


Figure S3 Ce XPS of reduced (a) 0.5Ce-Cu/SiO₂, (b) 1Ce-Cu/SiO₂, (c) 1.5Ce-Cu/SiO₂, and (d) 2Ce-Cu/SiO₂ catalysts.

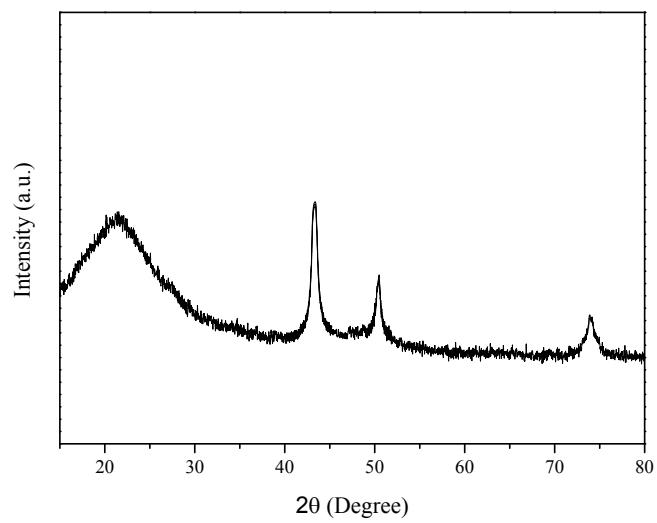


Figure S4 XRD pattern of spent Cu/SiO₂ catalyst after 100 h reaction.

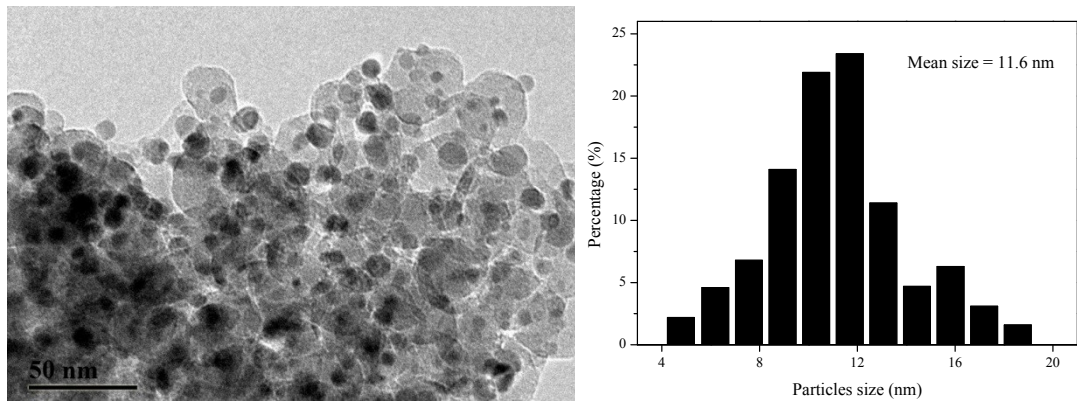


Figure S5 TEM image and particles size distribution of spent Cu/SiO₂ catalyst.

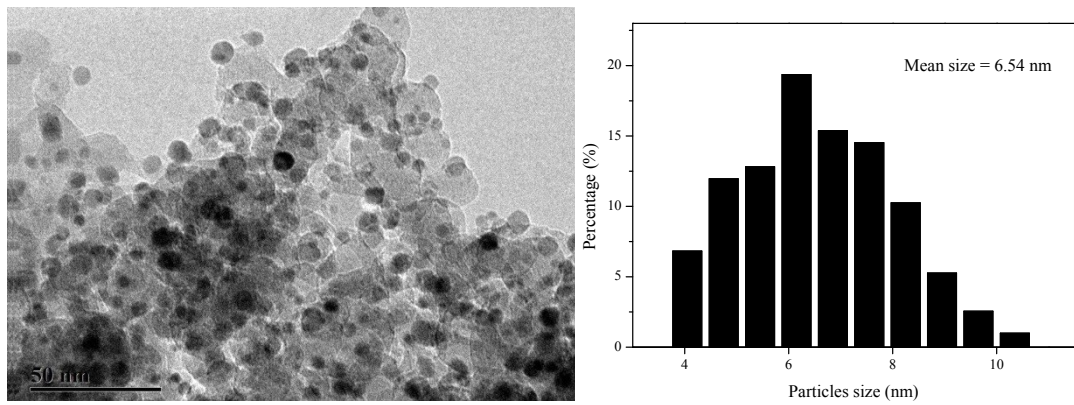


Figure S6 TEM image and particles size distribution of spent 1Ce-Cu/SiO₂ catalyst.

Table S1 Catalytic performance of 1Ce-Cu/SiO₂ catalysts under different reaction temperature

Catalyst	T	Conv. (%)	Sel. (%)			
			Ethanol	MG	EG	Others
1Ce-Cu/SiO ₂	300	100.0	88.6	0.8	0.8	9.8
1Ce-Cu/SiO ₂	280	100.0	91.8	0.5	0.7	7.0
1Ce-Cu/SiO ₂	260	99.8	73.2	1.0	9.8	16.0
1Ce-Cu/SiO ₂	240	99.8	31.3	0.5	55.7	12.5
1Ce-Cu/SiO ₂	220	99.5	8.6	0.6	85.4	5.4
1Ce-Cu/SiO ₂	200	99.5	2.2	0.1	95.7	2.0
1Ce-Cu/SiO ₂	180	87.9	0.6	22.9	71.7	4.8

Reaction conditions: P = 2.5 MPa, WHSV = 0.8 h⁻¹, H₂/DMO molar ratio = 200, reaction time= 8 h. MG: methyl glycolate, EG: ethylene glycol, others mainly consist of methyl methoxyacetate, methyl acetate, 1, 2-propanediol, 1, 2-butanediol and dimethyl carbonate.