Supporting Information

Hollow copper-ceria microspheres with single and multiple shells for preferential CO oxidation

Xie Yu, ‡[a] Jingfang Wu, ‡[a] Aiai zhang,[a] Lei Xue,[a] Qi Wang,[a] Xiaopeng Tian,[a] Shiyao Shan,[b] Chuan-Jian Zhong[b] and Shanghong Zeng*[,a]

[a] Inner Mongolia Key Laboratory of Chemistry and Physics of Rare Earth Materials, School of Chemistry and Chemical Engineering, Inner Mongolia University, Hohhot 010021, China
[b] Department of Chemistry, State University of New York at Binghamton, Binghamton, New York 13902, United States
(& These authors contributed equally to this work and should be considered co-first authors)
(* To whom correspondence should be addressed. Emails: zengshanghong@imu.edu.cn; cjzhong@binghamton.edu)

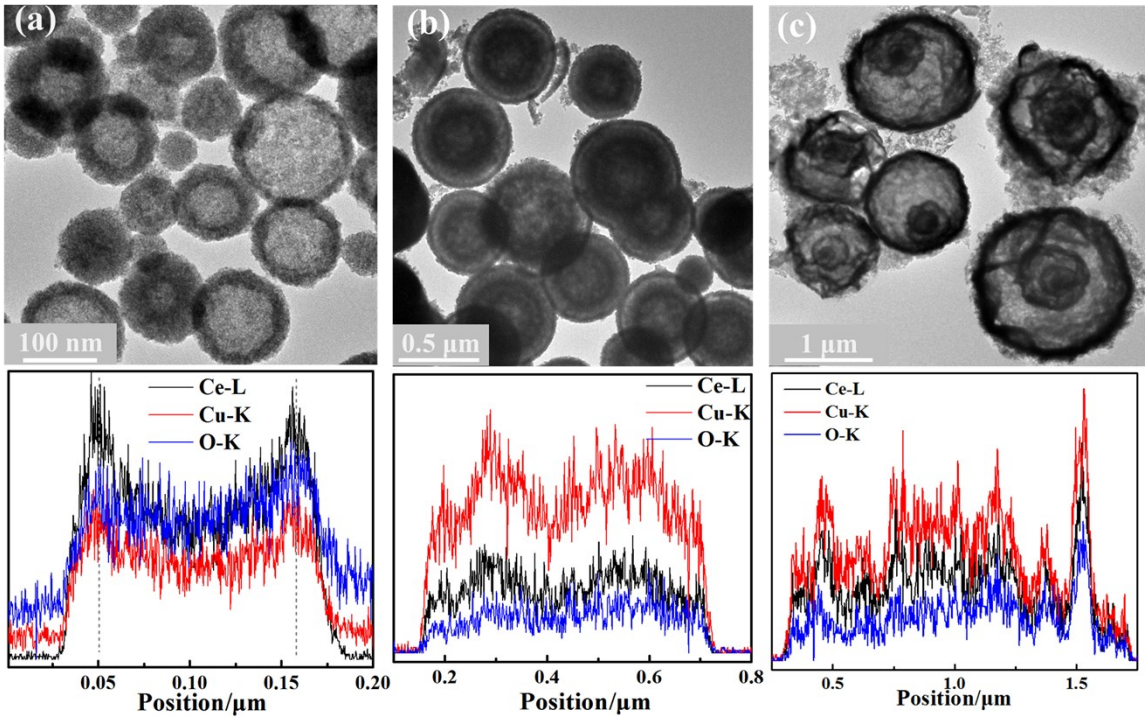

Fig. S1 TEM images and the corresponding line-scan profiles of (a) SSCuO/CeO_2 and (b) DSCuO/CeO_2 and (c)TSCuO/CeO_2 catalyst.

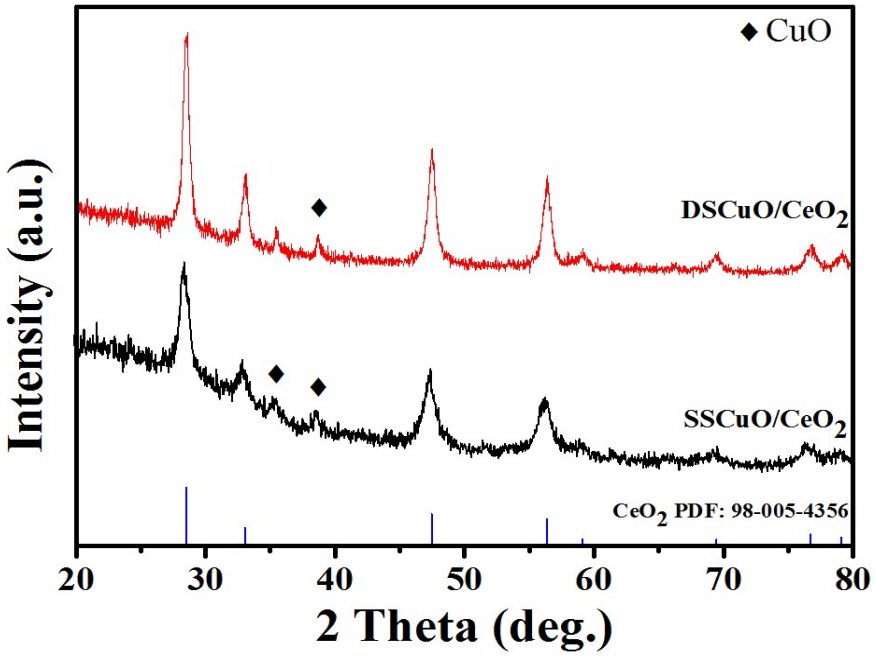

Fig. S2 XRD patterns of the SSCuO/CeO_2 and DSCuO/CeO_2 catalysts.

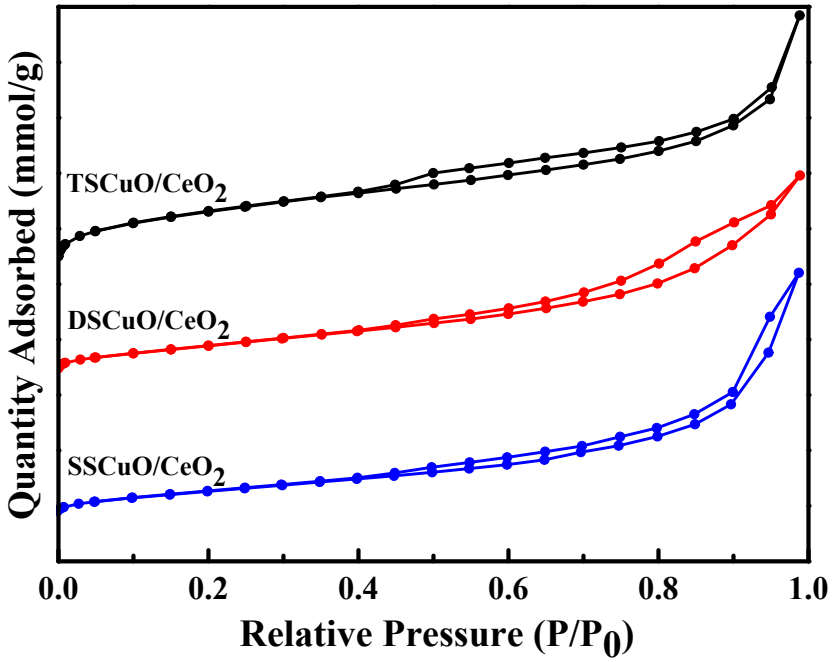

Fig. S3 N_2 adsorption/desorption isotherms of the multi-shelled CuO/CeO_2 hollow microspheres.

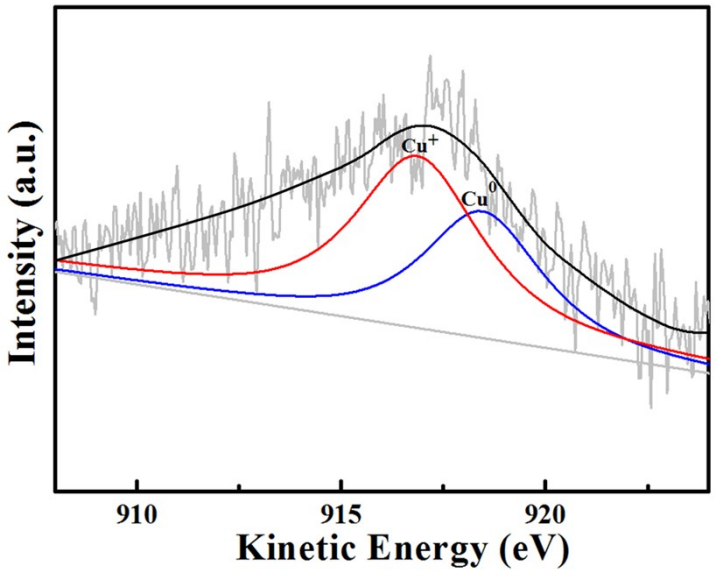

Fig. S4 CuLMM AES spectrum of the TSCuO/CeO_2 catalyst

Generally, peaks at 916 eV, 918 eV and 918.6 eV correspond to Cu^+, Cu^{2+} and Cu^0, respectively. Herein as shown in Fig. S4, there is a broad Auger line centered at 917 eV due to the overlap of the signals of Cu^+ and Cu^{2+} [S1, S2]. Therefore, the reduced copper species are mainly composed of Cu^+.

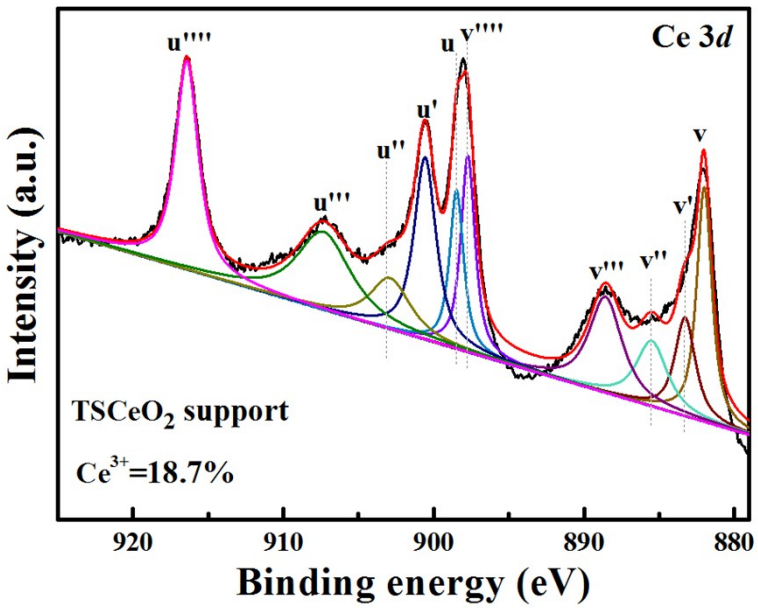

Fig.S5 XPS spectrum of Ce 3*d* region for $TSCeO_2$ support

Table S1 Binding energy (BE) of Cu 2p peak and the relevant areas for given samples.

		$SSCuO/CeO_2$		$DSCuO/CeO_2$		$TSCuO/CeO_2$	
		BE (eV)	area	BE (eV)	area	BE (eV)	area
$2p_{3/2}$	Main peaks	933.3	14213	933.6	14848	933.3	8766
		934.8	10019	935.0	11596	934.6	9455
	Satellite peaks	942.4	13364	941.2	7788	941.4	4626
		--	--	943.7	6271	943.8	4451
$2p_{1/2}$	Main peaks	953.7	11426	954.0	13245	953.9	13666
	Satellite peaks	962.5	3858	962.4	6680	962.3	8636

Table S2 Binding energy (BE) of Ce 3d peak and the relevant areas for given samples.

		$SSCuO/CeO_2$		$DSCuO/CeO_2$		$TSCuO/CeO_2$	
		BE (eV)	area	BE (eV)	area	BE (eV)	area
Ce^{3+}	v	882.2	16490	882.4	22012	882.4	19355
	v``	885.3	8920	885.9	10412	885.0	10173
	u	898.9	11074	899.2	11142	898.9	15148
	u``	902.3	8788	902.6	10917	902.6	8923
Ce^{4+}	v`	883.3	14738	883.9	12101	883.5	8709
	v```	888.9	17908	889.2	19758	888.9	20025
	v`````	898.0	13106	898.1	16676	898.0	10709
	u`	900.9	15790	900.9	19513	900.9	20462
	u```	907.4	17084	907.8	22709	907.9	20777
	u`````	916.8	24788	917.0	30407	916.9	29767

The TOF values was calculated from the following Equation [S3]:

$$TOF = \frac{\text{moles of reacted CO}}{(\text{moles of } CO_{surface}) \times \text{reaction time}} = \frac{\frac{\text{velocity of raw gases}}{1000 \times 22.4} \times \text{precent of CO} \times \text{converion of CO}}{\text{weight of catalysts} \times \text{content of CO} \times \frac{\text{dispersion}}{\text{relative moler mass}} \times 60}$$

Table S3 The CO conversion, Cu dispersion (D) and TOF values of the catalysts

Catalysts	CO conversion(%)[b]	D (%)[a]	TOF(s^{-1})[b]
$SSCuO/CeO_2$	31.6	2.58	0.12
$DSCuO/CeO_2$	81.5	2.66	0.59
$TSCuO/CeO_2$	100	5.00	0.74

a. Calculated from the D = 1/d;

b. Reaction temperature is 75 °C.

References

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