Supporting Information

Nanostructured CeO_2 with different morphologies for methoxycarbonylation of 2,4-toluene diamine with dimethyl carbonate

Mengli Dong, Han Yu, Xinqiang Zhao, Yao Lu, Hualiang An*, Yanji Wang*

Hebei Provincial Key Laboratory of Green Chemical Technology and Efficient Energy Saving, Tianjin Key Laboratory of Chemical Process Safety, School of Chemical Engineering and Technology, Hebei University of Technology, Tianjin 300130, China

* Corresponding authors: Yao Lu (ylu@hebut.edu.cn), Hualiang An (anhl@hebut.edu.cn)

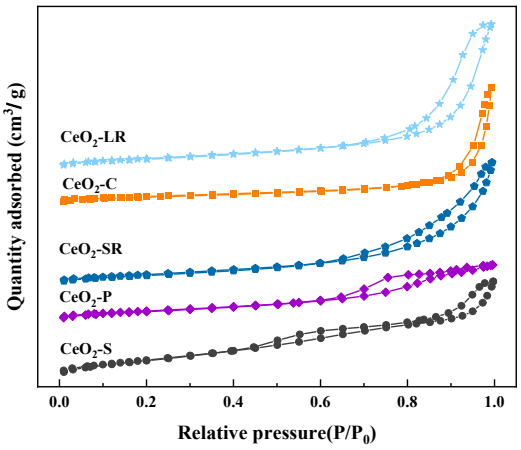

Figure S1. N_2 adsorption-desorption isotherms of CeO_2 with different morphologies

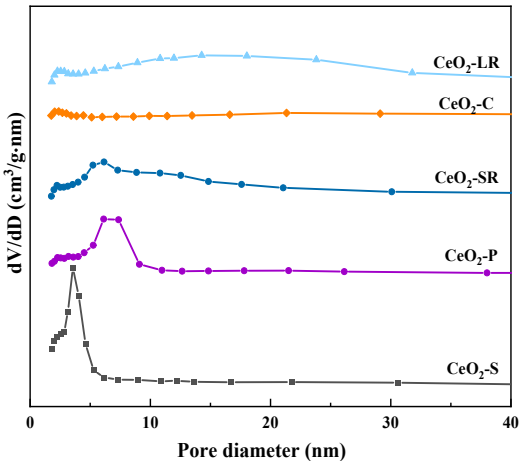

Figure S2. Pore size distribution of CeO_2 with different morphologies

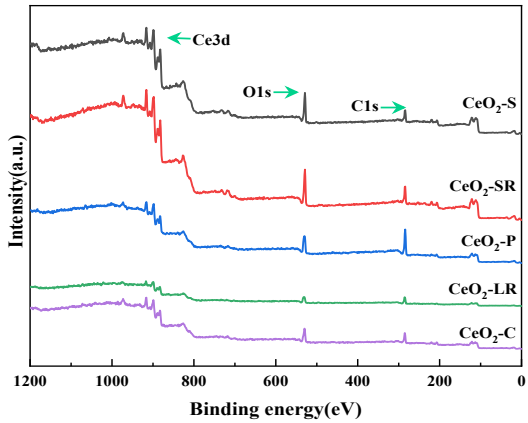

Figure S3. XPS spectra of CeO_2 catalysts with different morphologies

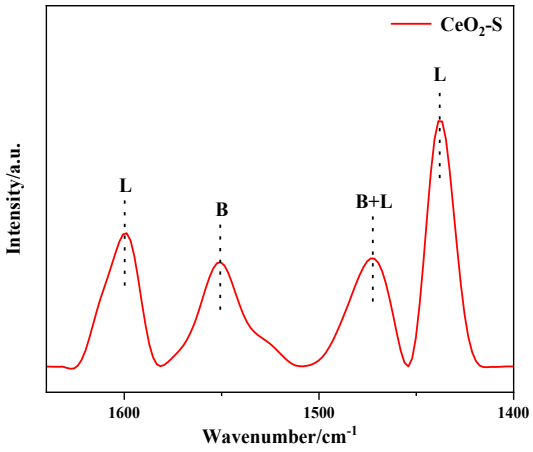

Figure S4. Py-FTIR spectrum of CeO_2-S

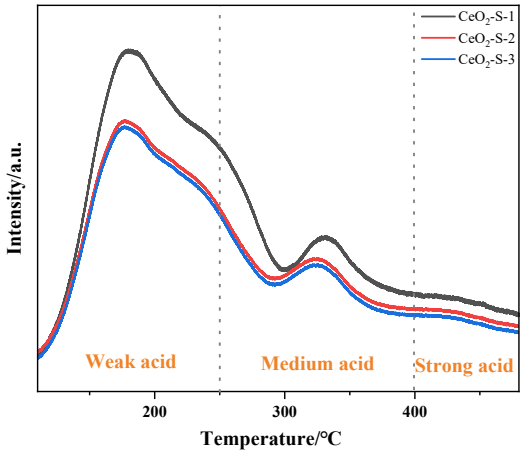

Figure S5. NH_3-TPD curves of the recycled CeO_2-S catalyst

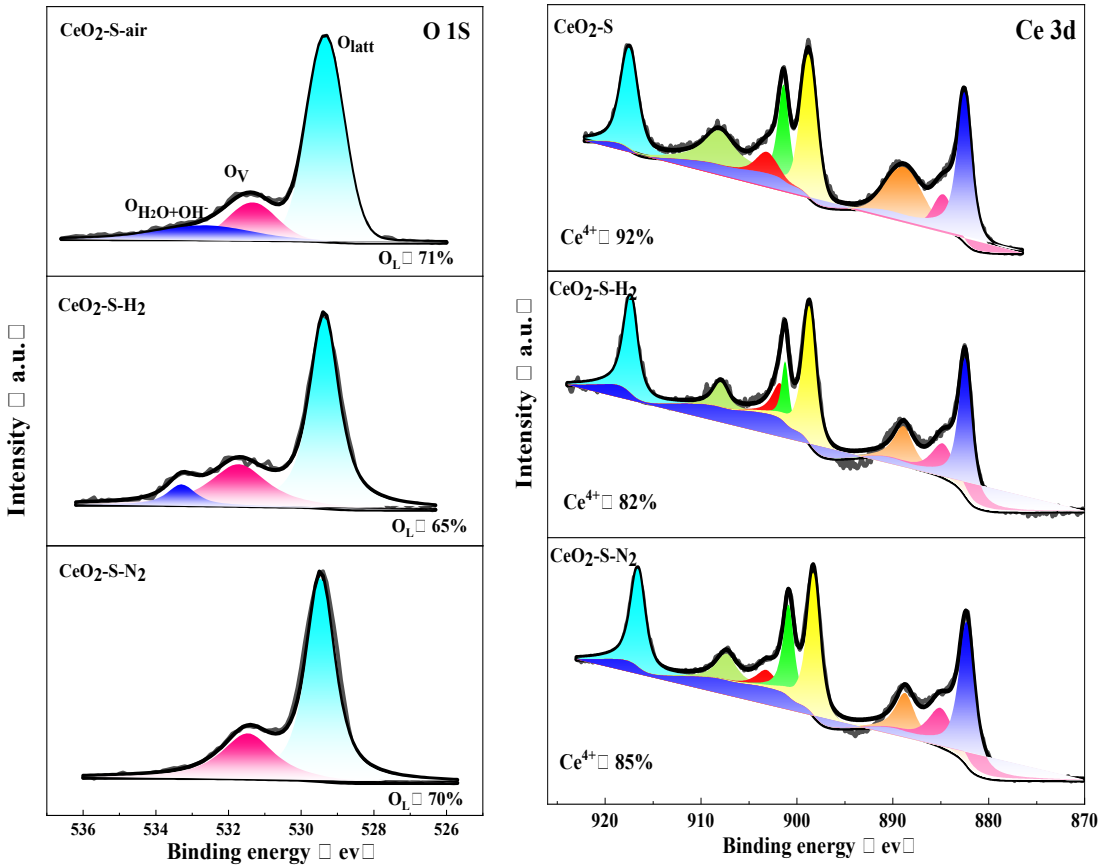

Figure S6. XPS spectra of CeO_2-S calcined at different atmospheres

Table S1. Acid-base amount of CeO_2 catalysts with different morphologies

Catalyst	Acid amount/μmol·g^{-1}				Base amount/μmol·g^{-1}			
	Weak	Medium	Strong	Total acid	Weak	Medium	Strong	Total base
CeO_2-S	35.19	19.64	5.78	60.60	49.54	23.61	6.60	79.76
CeO_2-SR	19.01	12.04	3.98	35.04	61.29	34.45	6.86	102.6
CeO_2-LR	19.26	10.20	2.85	32.31	20.36	14.96	6.62	41.95
CeO_2-P	23.40	6.48	0.05	29.93	22.88	9.94	1.92	34.74
CeO_2-C	3.81	4.07	0.00	7.88	8.48	1.37	0.16	10.01

Table S2. Effects of calcination atmosphere on CeO_2-S catalytic performance and XPS analysis

Catalyst	X_{TDA}/%	$S_{2\text{-}TMC}$/%	$S_{4\text{-}TMC}$/%	S_{TDC}/%	S_{total}/%	O_L/O_{total}	Ce^{4+}/Ce_{total}
CeO_2-S-air	100.0	2.8	6.9	86.8	96.5	0.71	0.92
CeO_2-S-N_2	100.0	2.5	10.6	73.2	86.3	0.70	0.85
CeO_2-S-H_2	100.0	2.5	6.4	72.2	81.1	0.65	0.82

Reaction conditions: TDA=0.25 g, DMC=6 mL, CeO_2-S=0.25 g, 170 ℃, 10 h; P_{N2}=1.5 MPa; $S_{total}=S_{2\text{-}TMC+4\text{-}TMC+TDC}$. $O_{total}=O_{latt}+O_v+O_{H2O+OH^-}$. $Ce_{total}=Ce^{3+}+Ce^{4+}$.