Mild generation of surface oxygen vacancy on CeO_2 for improved CO_2 photoreduction activity

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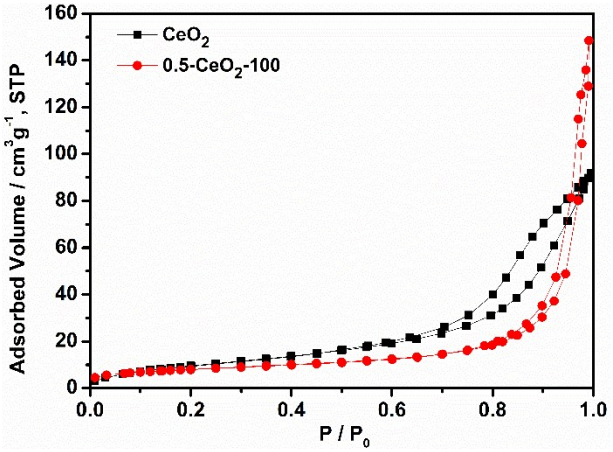

Fig. S1 The N_2 adsorption/desorption curves of CeO_2 and 0.5-CeO_2-100.

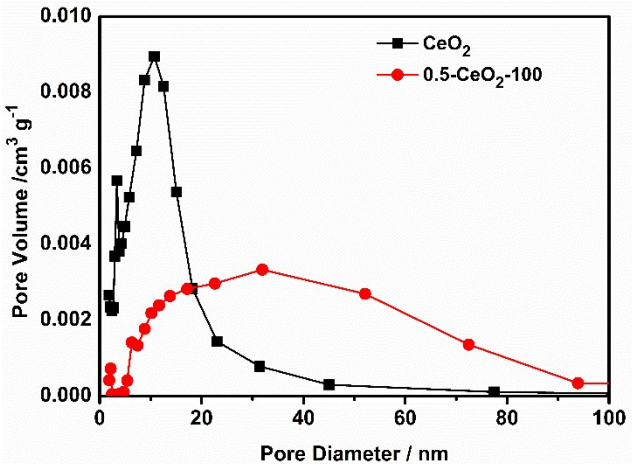

Fig. S2 The pore size distribution curves of CeO_2 and 0.5-CeO_2-100.

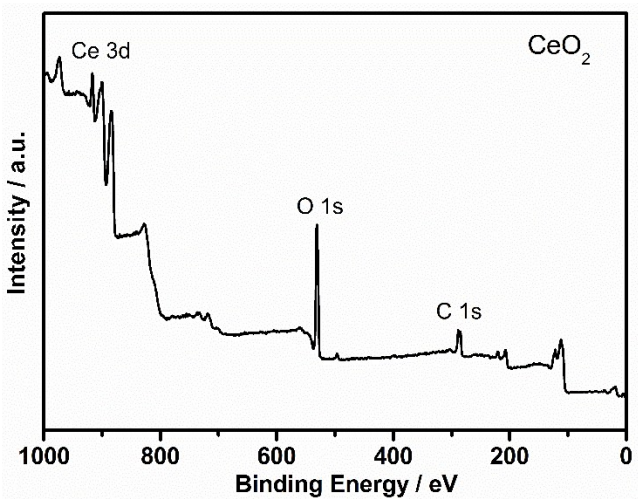

Fig. S3 The XPS survey spectrum of CeO_2.

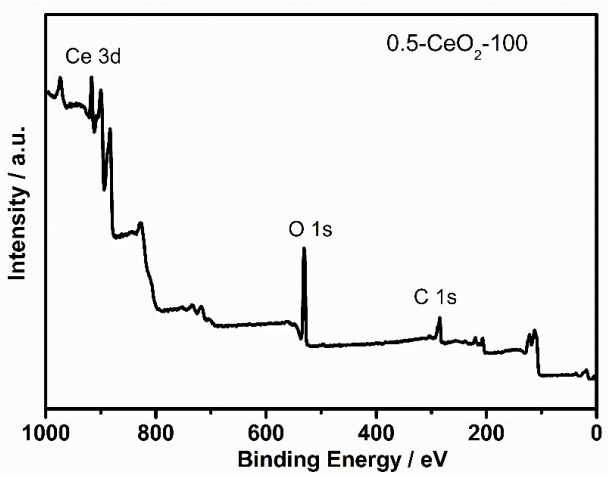

Fig. S4 The XPS survey spectrum of 0.5-CeO_2-100.

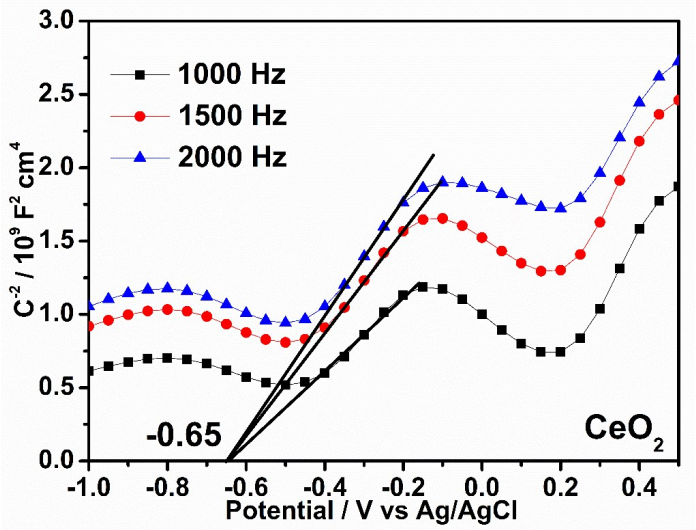

Fig. S5 The Mott-Schottky plots of CeO_2 at different frequencies.

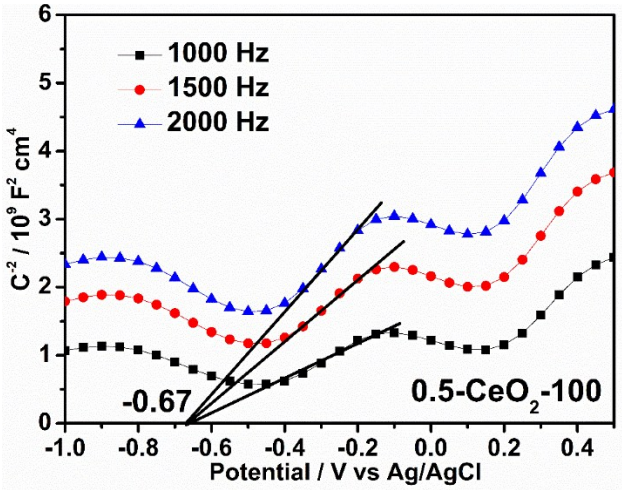

Fig. S6 The Mott-Schottky plots of 0.5-CeO_2-100 at different frequencies.

Table S1 The full width at half-maximum (FWHM) and oxygen vacancy concentration of CeO_2 and 0.5-CeO_2-100.

Samples	HWHM (cm^{-1})	oxygen vacancy concentration ($\times 10^{20}$ cm^{-3})
CeO_2	50.1	0.02
0.5-CeO_2-100	27.3	1.06

Table S2 CO_2 photoreduction activity of CeO_2 previously reported and in this work.

Strategy	Product	The yield of product	Reference
Oxygen vacancy introduced CeO_2	CO	1.4 μmol/g (5 h)	This work
Oxygen vacancy introduced CeO_2	CH_3OH	5.8 μmol/g (10 h)	1
Cu_2O-decorated CeO_2	CO	1.2 μmol/g (8 h)	2
Cr-doped CeO_2	CO	16.2 μmol/g (8 h)	3
	CH_4	10.1 μmol/g (8 h)	
Cu and oxygen vacancy introduced CeO_2	CO	12.55 μmol/g (5 h)	4
Zr-doped CeO_2	CO	8 μmol/g (8 h)	5
Pt-embedded CeO_2	CO	6.0 mmol/min/g	6
CeO_2/Bi_2MoO_6 heterojunction	CH_3OH	32 μmol/g (4 h)	7
	C_2H_5OH	25 μmol/g (4 h)	

1. Abdo Hezam, Keerthiraj Namratha, Q. A. Drmosh Deepalekshmi Ponnamma, Jingwei Wang, Suchitra Prasad, Momin Ahamed, Chun Cheng and Kullaiah Byrappa, ACS Appl. Nano Mater. 2020, 3, 138−148.
2. Yu Pu , Yidan Luo , Xiaoqian Wei , Jingfang Sun , Lulu Li , Weixin Zou and Lin Dong, Appl. Catal. B: Environ., 2019, 254, 580–586.
3. Yangang Wang, Xia Bai, Fei Wang, Shifei Kang, Chaochuang Yin and Xi Li, J. Hazard. Mater., 2019, 372, 69−76.

4. Min Wang, Meng Shen, Xixiong Jin, Jianjian Tian, Mengli Li, Yajun Zhou, Lingxia Zhang, Yongsheng Li and Jianlin Shi, ACS Catal. 2019, 9, 5, 4573−4581.
5. Lu Li,Pan Li, Yanjie Wang, Lin Lin, Aamir Hassan Shah and Tao He, Appl. Surf. Sci., 2018, 452, 498–506.
6. Mingyang Mao, Qian Zhang, Yi Yang, Yuanzhi Li, Hui Huang, Zhongkai Jiang, Qianqian Hu and Xiujian Zhao, Green Chem., 2018, 20, 2857−2869.
7. Weili Dai, Xu Hu, Tengyao Wang, Wuwan Xiong, Xubiao Luo and Jianping Zou, Appl. Surf. Sci., 2018, 434, 481–491.