gkElectronic Supplementary Information for

Defect-rich CeO_2 in a hollow carbon matrix engineered from a microporous organic platform: a hydroxide-assisted high performance pseudocapacitive material

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Fig. S1. SEM and TEM images of (a, d) H-MOP, (b, e) H-MOP/CeO_2-4, and (c, f) P-CeO_2.

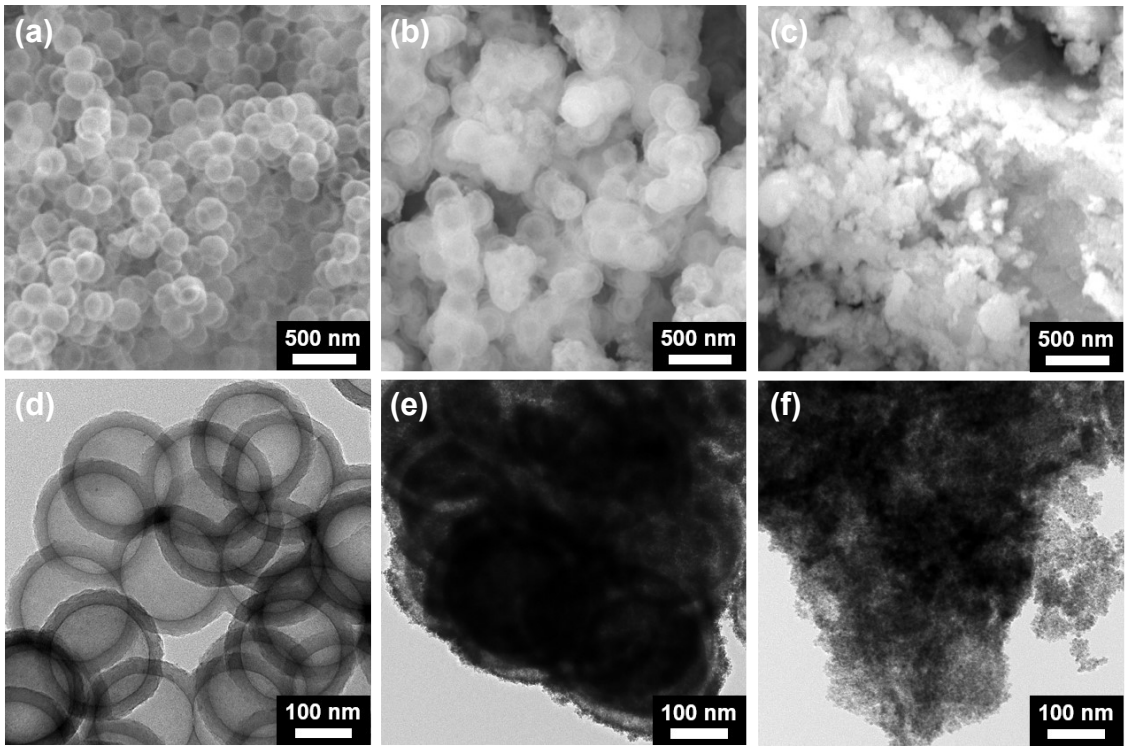


Fig. S2. Characterization data of H-MOP/CeO_2-4 and H-C/CeO_2-4: (a) N_2 adsorption-desorption isotherm curves (77K) and a pore size-distribution diagrams (based on the DFT method) and (b) PXRD patterns. Also, refer to Table S1 in the ESI.

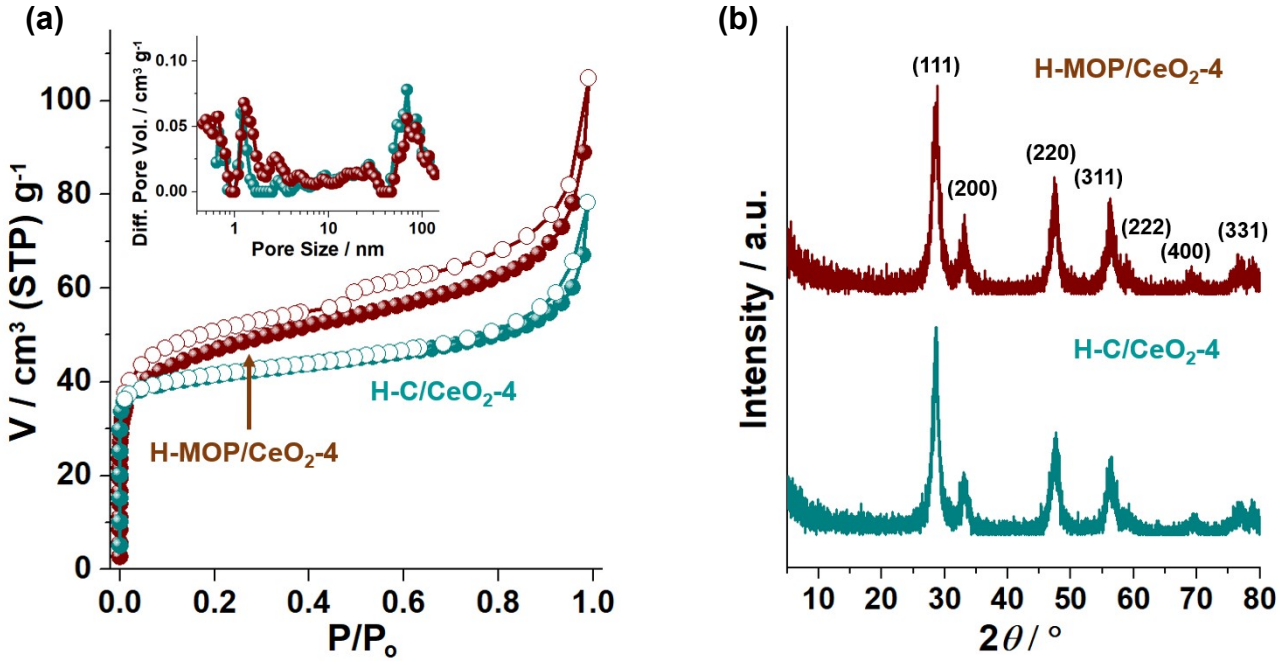


Fig. S3. N_2 adsorption-desorption isotherm curves (at 77K) and a pore size-distribution diagrams (based on the DFT method) of P-CeO_2 and CeO_2. Also, refer to Table S1 in the ESI.

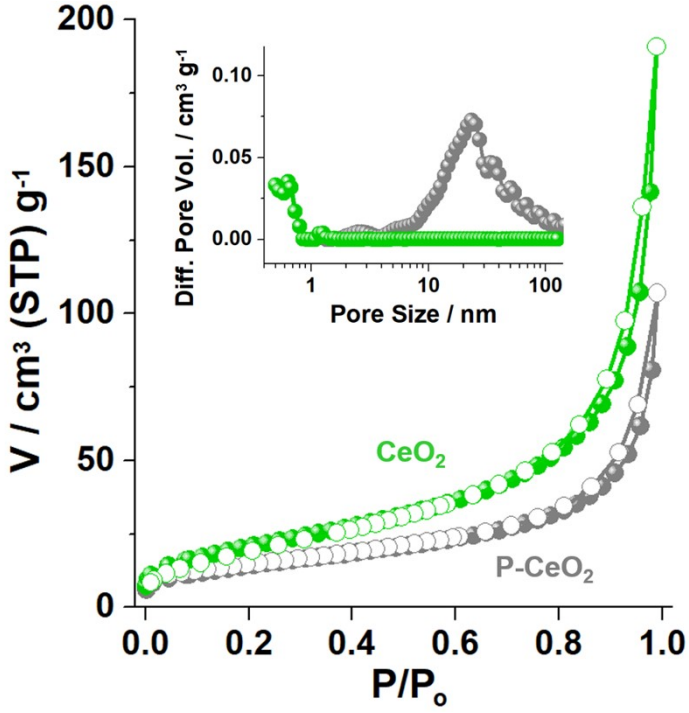
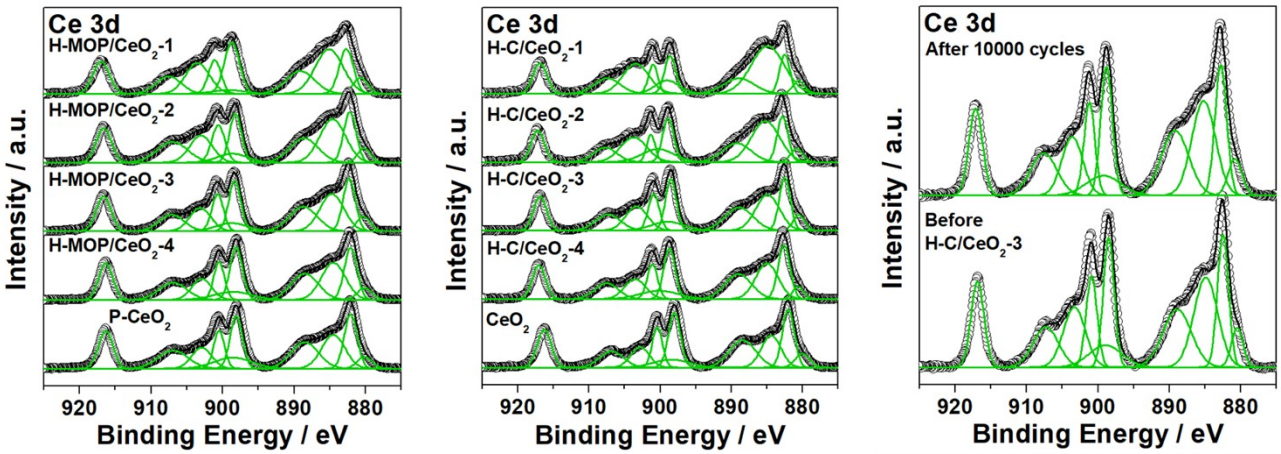


Fig. S4. Quantitative analysis of $Ce^{3+}/(Ce^{3+} + Ce^{4+})$ through the XPS Ce 3d orbital peak fitting (refer to K. I. Maslakov, Y. A. Teterin, A. J. Popel, A. Y. Teterin, K. E. Ivanov, S. N. Kalmykov, V. G. Petrov and I. Farman, *Appl. Surf. Sci.* 2018, **448**, 154-162 and Y. Zhou, J. M. Perket and J. Zhou, *J. Phys. Chem. C* 2010, **114**, 11853-11860.)



Materials	$Ce^{3+}/(Ce^{3+} + Ce^{4+})$
H-MOP/CeO_2-1	0.40
H-MOP/CeO_2-2	0.38
H-MOP/CeO_2-3	0.36
H-MOP/CeO_2-4	0.34
P-CeO_2	0.33
H-C/CeO_2-1	0.54
H-C/CeO_2-2	0.49
H-C/CeO_2-3	0.38
H-C/CeO_2-3 (after 10000 cycles)	0.36
H-C/CeO_2-4	0.35
CeO_2	0.30

Fig. S5. TGA curves of H-MOP and H-MOP/CeO_2.

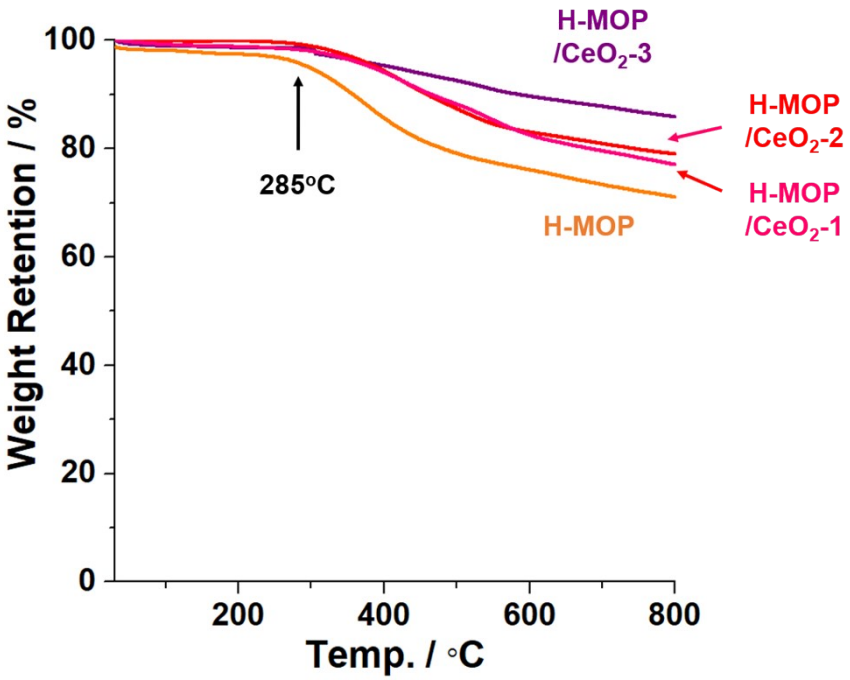


Fig. S6. SEM images of H-C, H-C/CeO_2, and CeO_2.

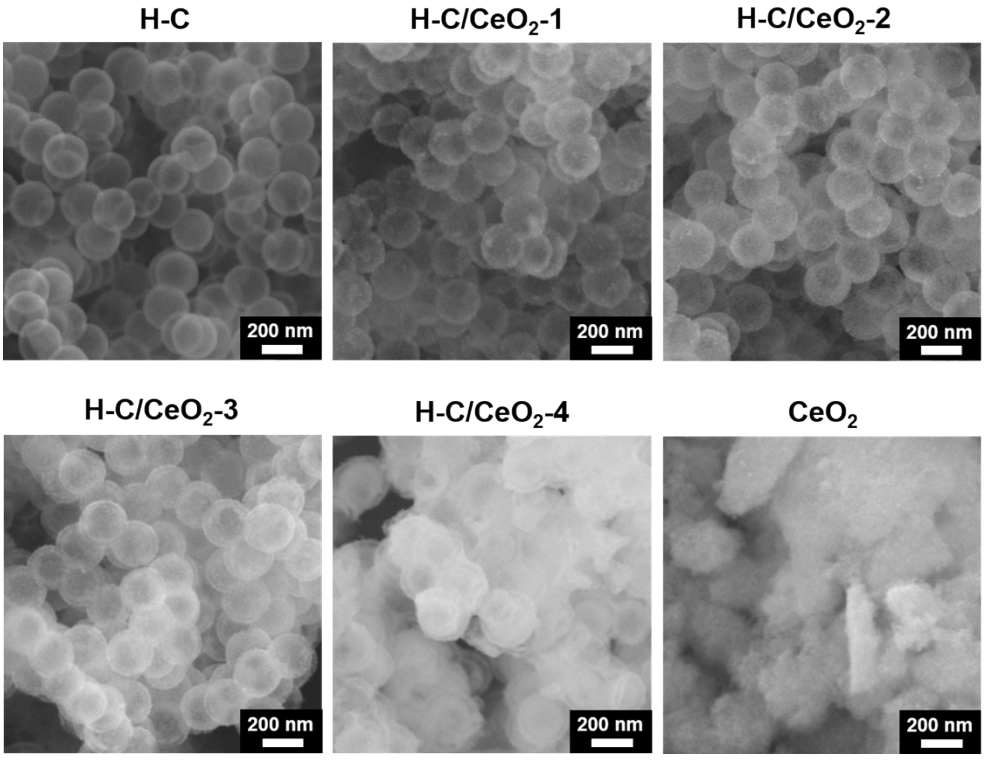


Fig. S7. (a) HR-TEM and (b) EDS-elemental mapping images of H-C/CeO_2-3.

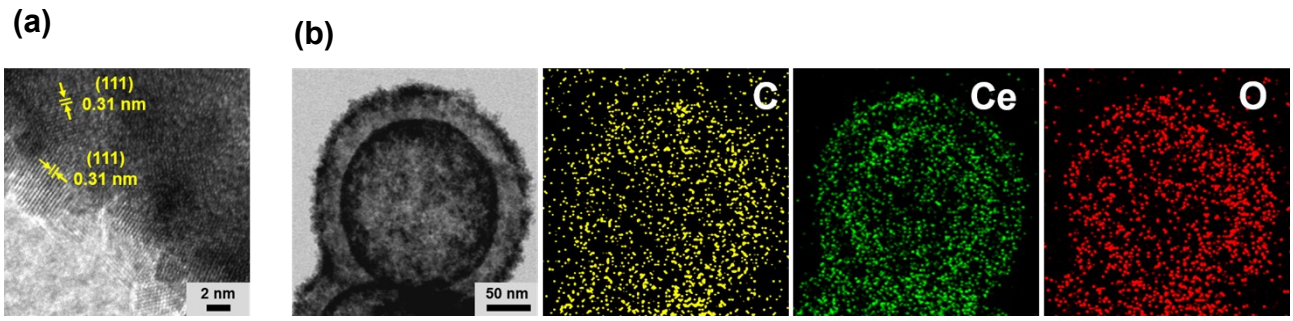


Fig. S8. EPR spectra of H-C, H-C/CeO_2, and CeO_2 (a modulation frequency of 100 kHz, RT).

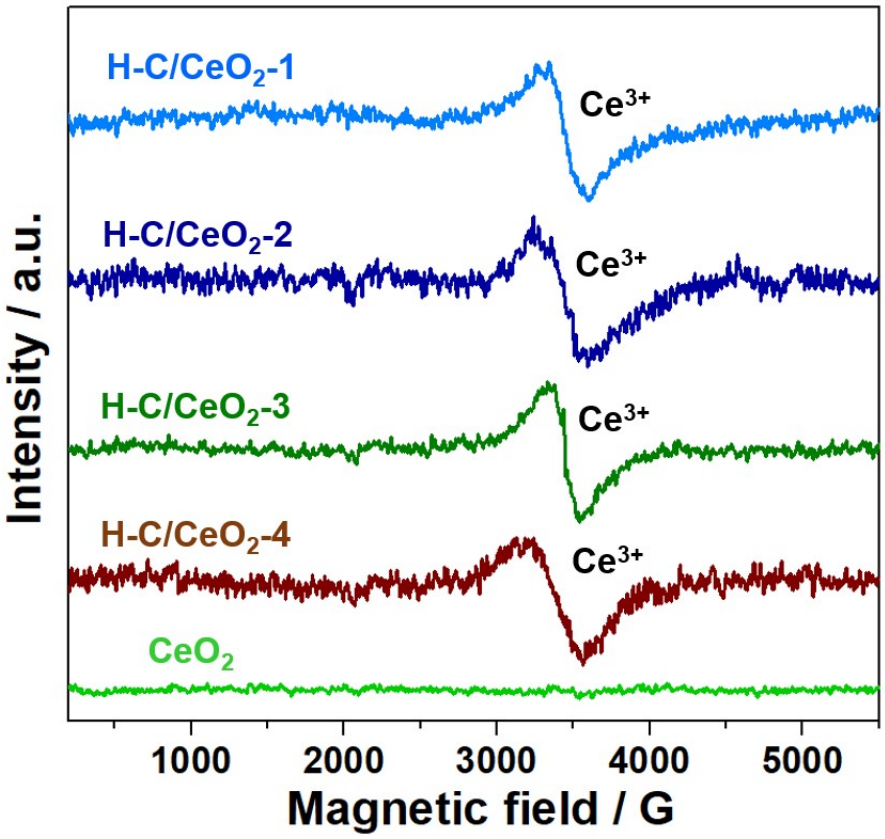


Fig. S9. Scan rate-dependent cyclic voltammograms of H-C, H-C/CeO_2, and CeO_2.

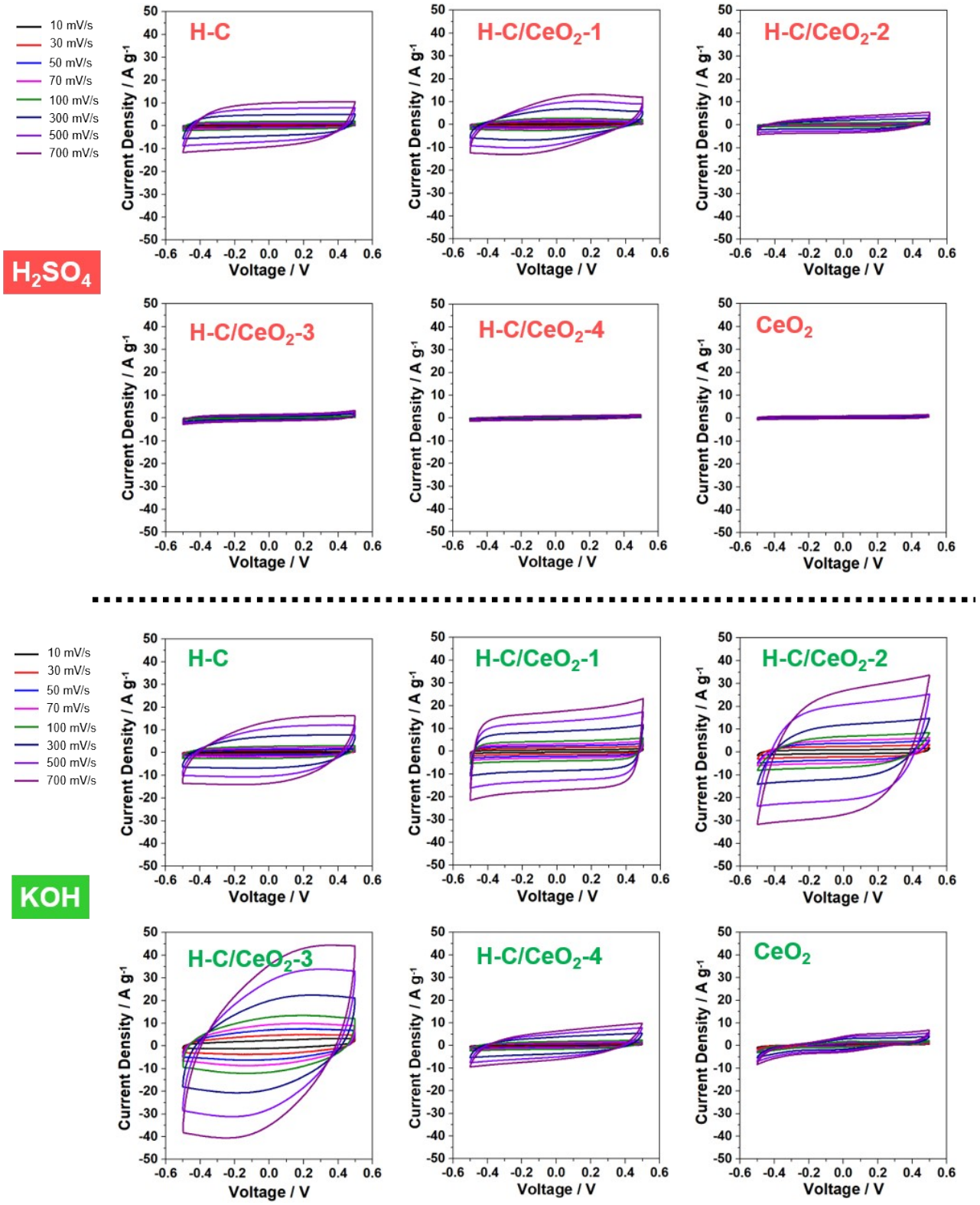


Fig. S10. Electrochemical performance of H-C/CeO_2-4: (a) Rate performance and (b) Nyquist plots.

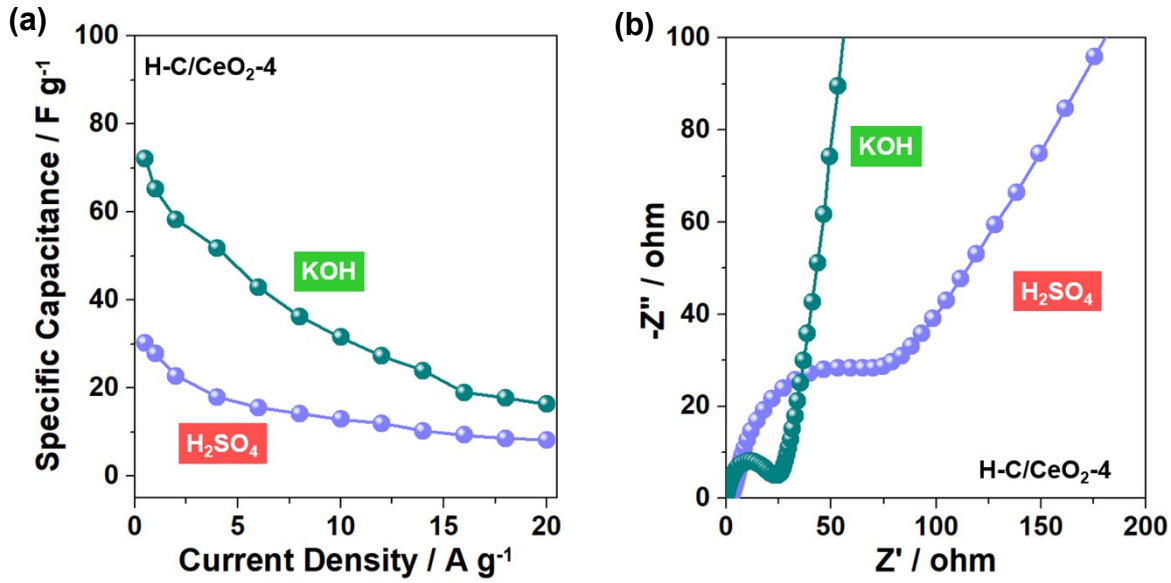


Fig. S11. (a) TEM images, (b) charge-discharge profiles, (c) rate performance, and (d) Nyquist plots of H-C/CeO_2-3-600, H-C/CeO_2-3-900, and H-C/post-loaded CeO_2. The H-C/CeO_2-3-600 and H-C/CeO_2-3-900 were prepared by the heat-treatment of H-MOP/CeO_2-3 in a furnace under argon for 4 h at 600 and 900°C, respectively. The H-C/post-loaded CeO_2(57wt%) was prepared by the synthetic procedures applied for H-MOP/CeO_2-3 using the H-C instead of H-MOP.

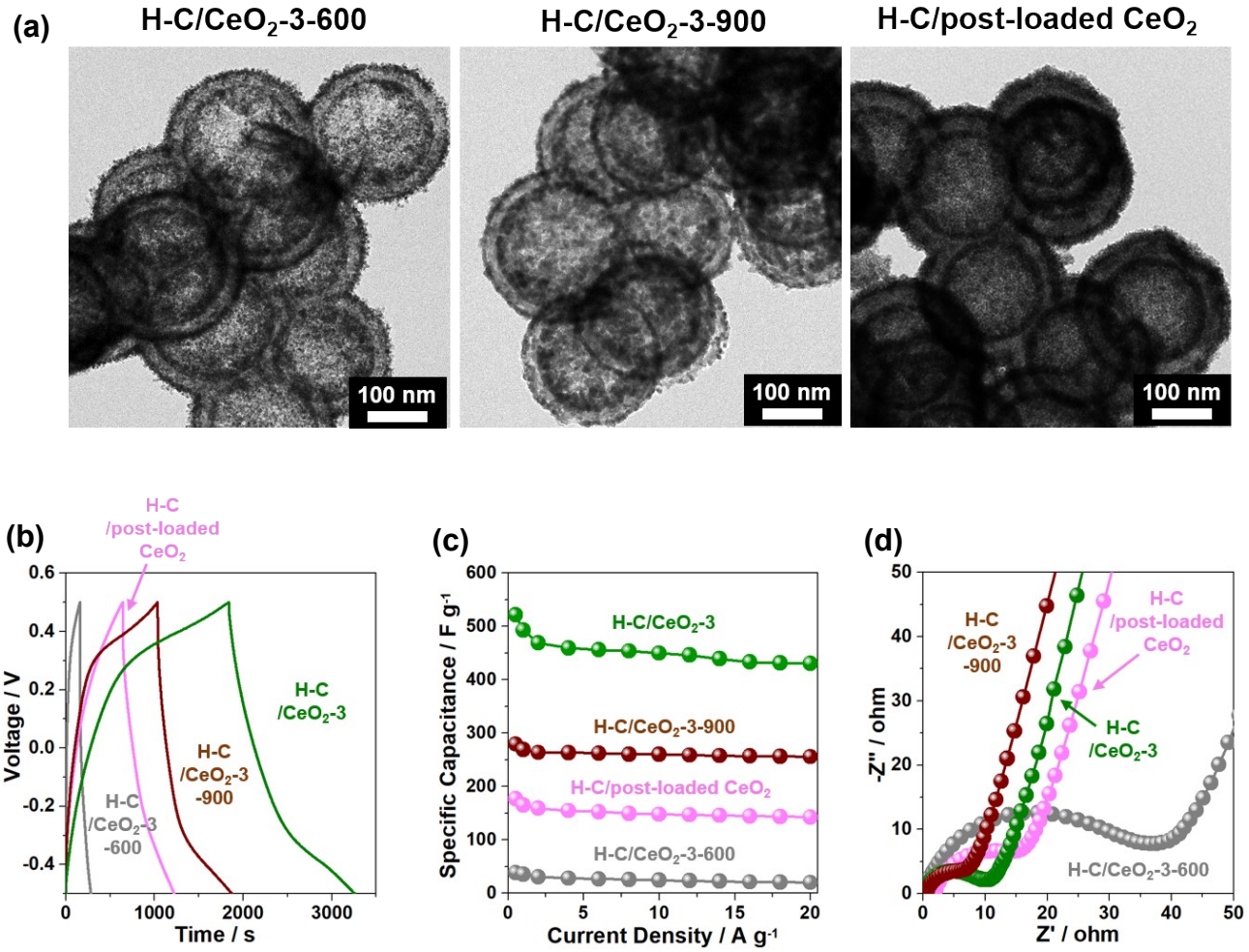


Fig. S12. TEM images of H-C/CeO_2-3 retrieved after 10000 cycles.

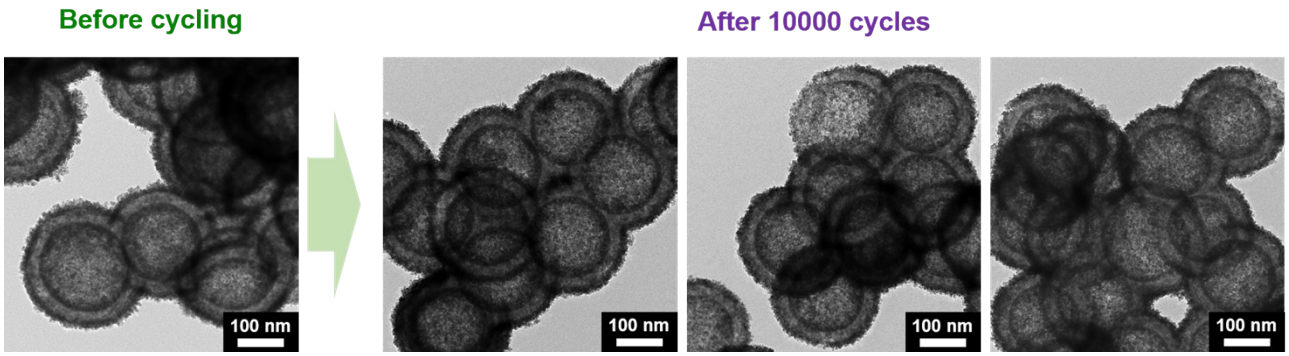


Table S1. Physical and electrochemical properties of H-MOP, H-MOP/CeO_2, P-CeO_2, H-C, H-C/CeO_2, and CeO_2.

Entry	Materials	S_{BET}[a] (m^2/g)	V_{mic}[b] (cm^3/g)	Specific Capacitance (F/g)[c]		
				0.5 A/g	1 A/g	10 A/g
1	H-MOP	745	0.24	-	-	-
2	H-MOP/CeO_2-1	534	0.17	-	-	-
3	H-MOP/CeO_2-2	403	0.12	-	-	-
4	H-MOP/CeO_2-3	282	0.08	-	-	-
5	H-MOP/CeO_2-4	152	0.04	-	-	-
6	P-CeO_2	54	0.00	-	-	-
7	H-C	1017	0.32	195	184	153
8	H-C/CeO_2-1	537	0.17	296	262	213
9	H-C/CeO_2-2	425	0.16	415	378	349
10	H-C/CeO_2-3	279	0.10	527	504	458
11	H-C/CeO_2-4	159	0.05	72	65	31
12	CeO_2	73	0.00	4.5	4.3	2.0

[a] Surface areas based on BET theory. [b] Micropore volumes based on t-plot. [c] The values in aqueous 6 M KOH electrolyte.

Table S2. Summarized energy storage performance of the recent carbonized CMP and CeO_2-based electrode materials.

Entry	Materials	Types of materials	Capacitance (F/g)								Measurement type	Ref.
			0.1 A/g	0.2 A/g	0.5 A/g	1 A/g	2 A/g	5 A/g	10 A/g	20 A/g		
1	N3-CMP-1	Carbonized CMP	175			164			149		three electrode	1
2	G-TEPA-TPA-C	Carbonized CMP		268							two electrode	2
3	NPCM-1	Carbonized CMP	264								two electrode	3
4	H-NCB-900	Carbonized CMP				286			224		two electrode	4
5	CeO_2/graphene	CeO_2/C composites				208					three electrode	5
6	CeO_2/graphene	CeO_2/C composites					185				three electrode	6
7	MnO_2/CeO_2	Doped CeO_2 materials			274.3	265.6		236.2			three electrode	7
8	CeO_2/graphene	CeO_2/C composites				86.5					two electrode	8
9	CeO_2/CNT	CeO_2/C composites				455.7	289.7				three electrode	9
10	Co-CeO_2/RGO	CeO_2/C composites				298					three electrode	10
11	Porous CeO_2	CeO_2 nanomaterials				134.6		116.2	109.5		three electrode	11
12	CeO_2 nanocubes	CeO_2 nanomaterials						88.71			three electrode	12
13	PANI/rGO/CeO_2	CeO_2/C composites				115.3			81.2		three electrode	13
14	Hollow CeO_2/MWCNT	CeO_2/C composites			450.5				389.7		three electrode	14
15	Cr-CeO_2	Doped CeO_2 materials			328						three electrode	15
16	CeO_2 nanocrystals	CeO_2 nanomaterials				339.5				161	three electrode	16
17	H-C/CeO_2-3	CeO_2/C composites			527	493			458	440	two electrode	This work

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