Supporting Information

MOF-derived hierarchical porous CeO_2/TiO_2 composite for highly efficient removal of high-concentration tetracycline by synergistic adsorption and photocatalysis

Lanshu Zhao, [a] Baolin Yan, *[a] Bo Yang, [a] Xinyu Zhao, [a] Linxin Zhang, [a] Shiyan An, *[b] Huaize Han, [a] Yihan Liu, [c] Yi'an Peng, [a] Yuhua Dai, [a] and Jianxiang Yu *[a]

[a] Beijing Key Laboratory of Special Elastomer Composite Materials, College of New Materials and Chemical Engineering, Beijing Institute of Petrochemical Technology, Beijing 102617, China. E-mail: yanbaolin@bipt.edu.cn
[b] China Academy of Information and Communications Technology, Beijing 100037, China. E-mail: anshiyan@caict.ac.cn
[c] Yanfeng Hainachuan Automotive Trim Systems Co., Ltd., Beijing 101300, China.

*Corresponding author.
E-mail:
yanbaolin@bipt.edu.cn
yujianxiang@bipt.edu.cn
anshiyan@caict.ac.cn

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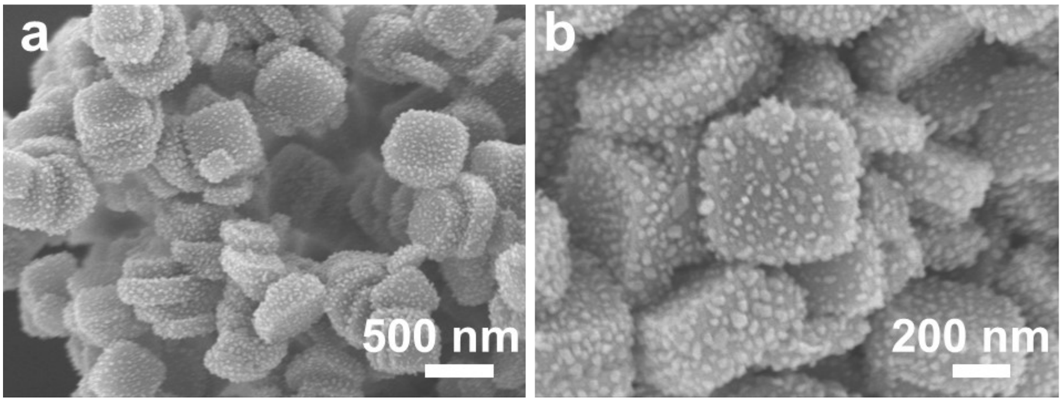

Fig. S1. SEM images of the NM-derived TiO_2 by calcination of NM at 800 ^oC under a N_2 atmosphere for 2 h with a heating rate of 5 ^oC min^{-1}.

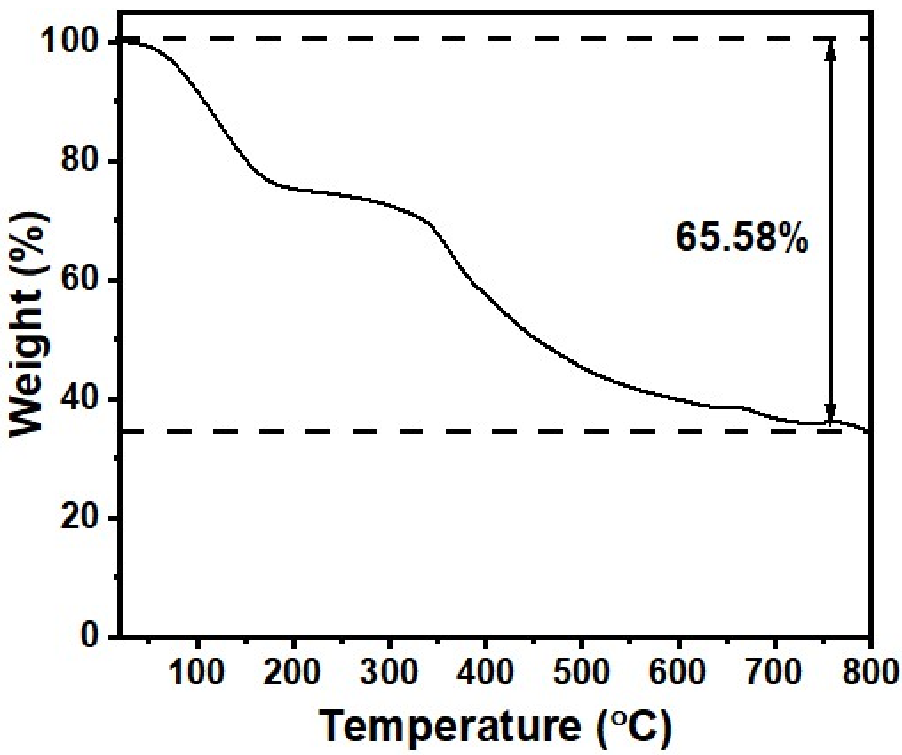

Fig. S2. TGA curve of the Ce-NM in a N_2 atmosphere with a heating rate of 10 ^{o}C min^{-1}.

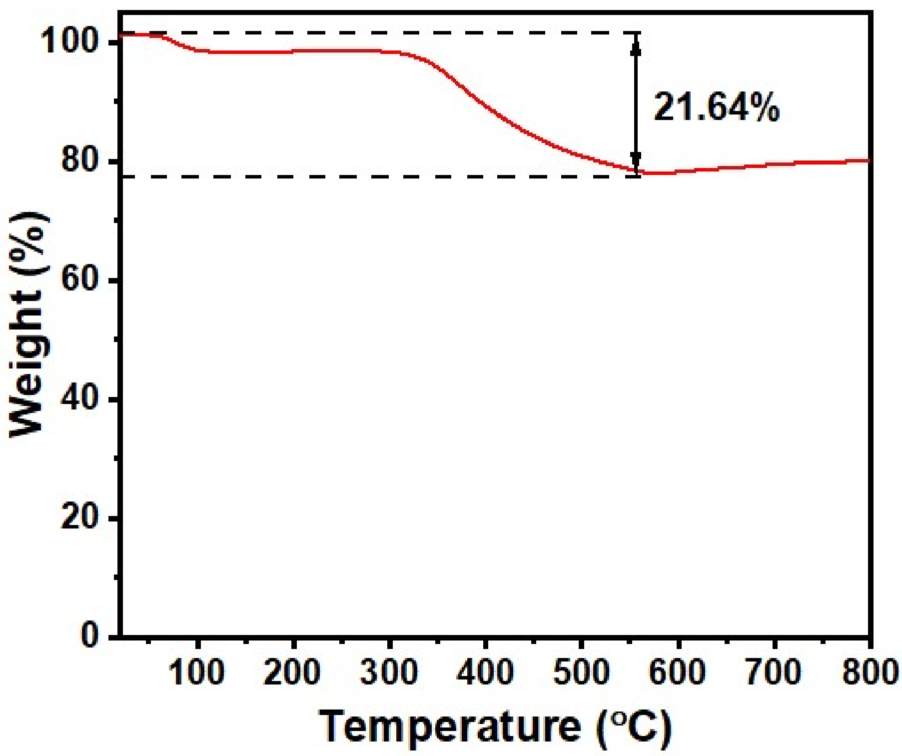

Fig. S3. TGA curve of CeO_2/TiO_2 in an Air atmosphere with a heating rate of 10 ^{o}C min^{-1}.

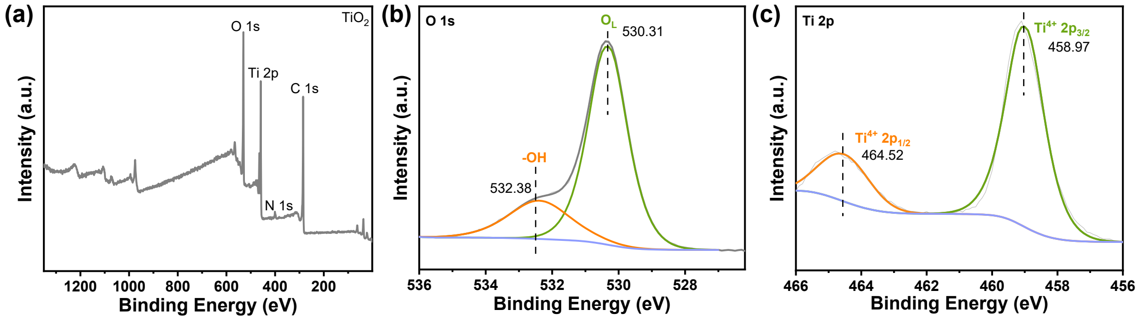

Fig. S4. XPS spectra of (a) survey, (b) O 1s, and (c) Ti 2p of NM-derived TiO_2.

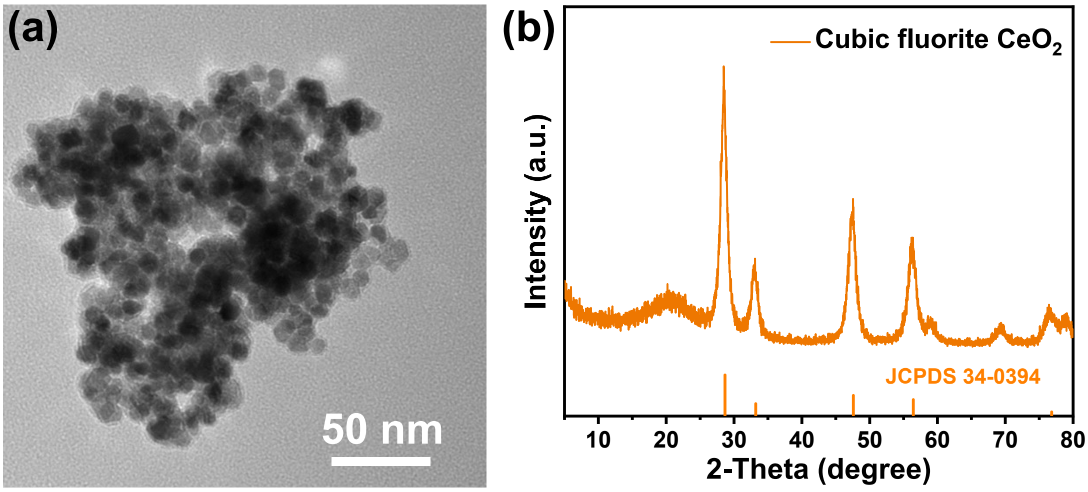

Fig. S5. (a) The TEM image and (b) XRD pattern of CeO_2.

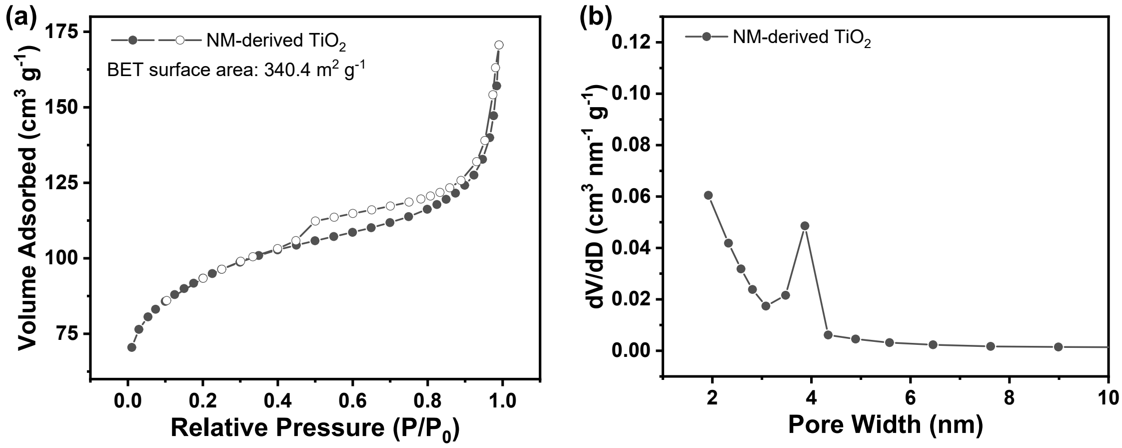

Fig. S6. (a) N_2 adsorption-desorption isotherm and (d) corresponding pore size distribution of NM-derived TiO_2.

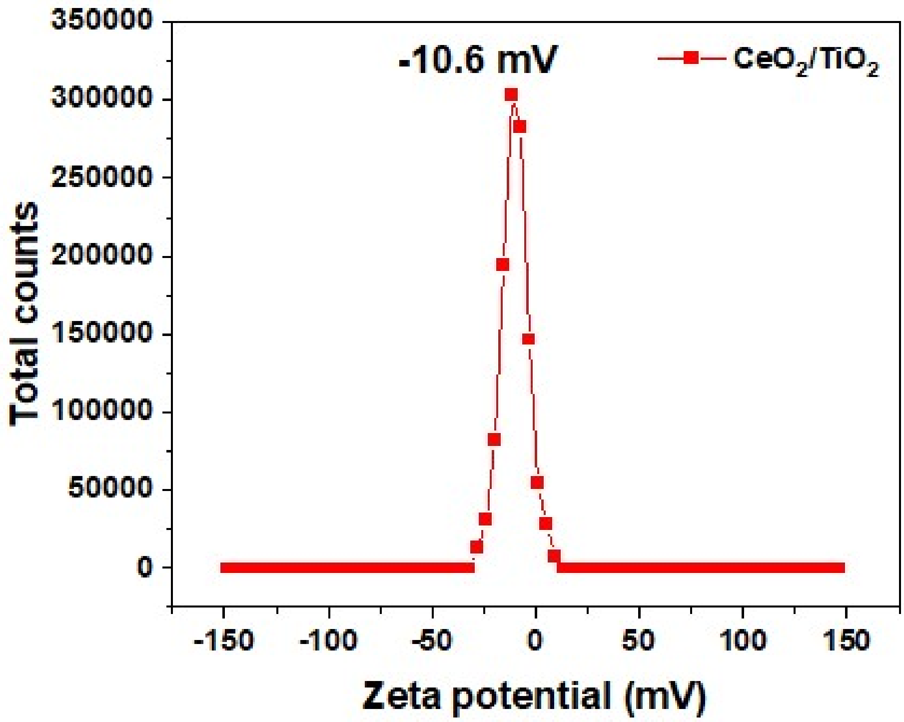

Fig. S7. Zeta potentials of CeO_2/TiO_2 in water.

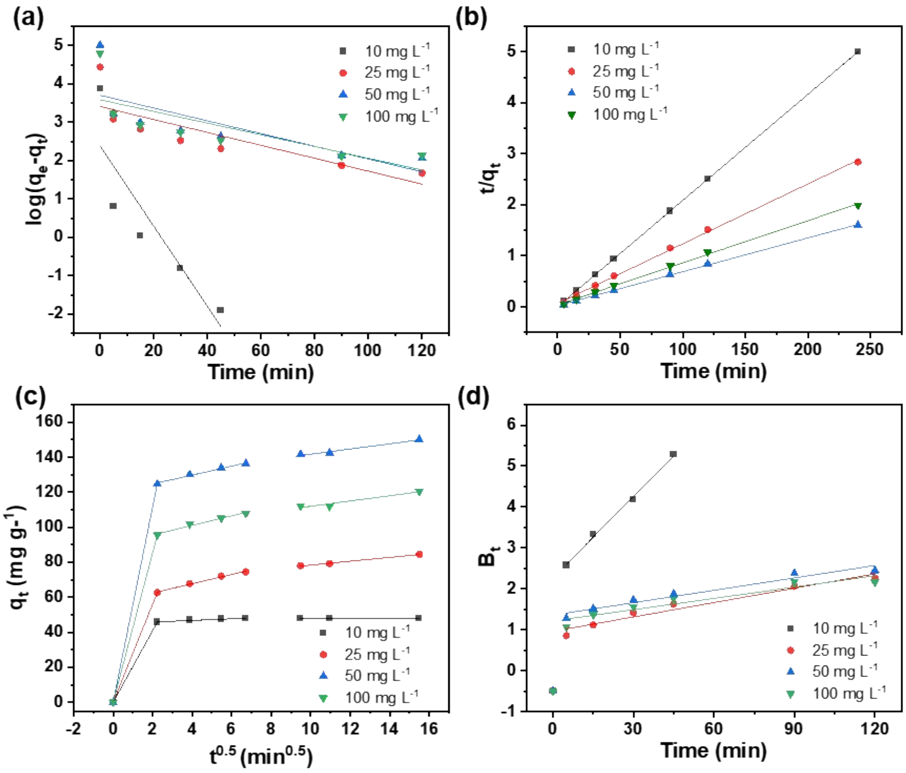

Fig. S8. Dynamics simulation for TC adsorption onto CeO_2/TiO_2 composite. (a) pseudo-first-order model, (b) pseudo-second-order model, (c) Intra-particle diffusion model, and (d) Boyd model.

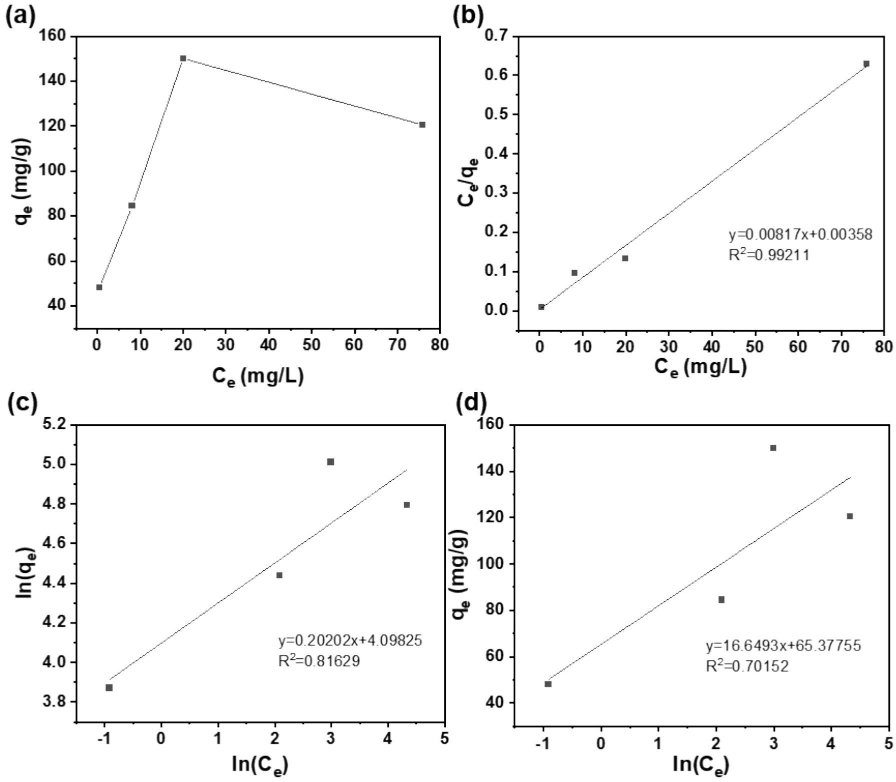

Fig. S9. (a) Adsorption isotherms for TC adsorption on CeO_2/TiO_2, (b) Langmuir fit, (c) Freundlich fit, and (d) Temkin fit.

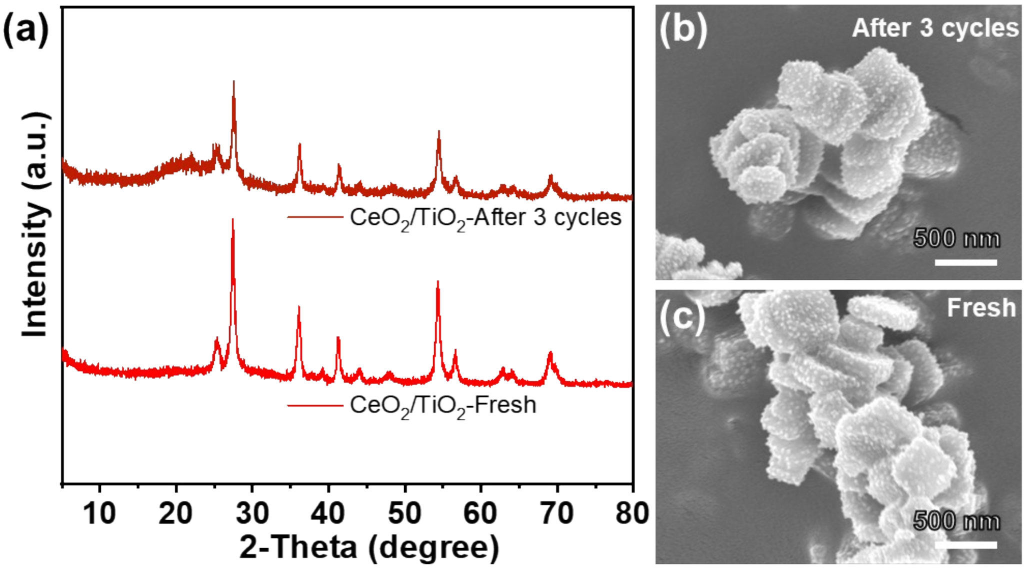

Fig. S10. (a) XRD patterns and (b-c) SEM images of the CeO_2/TiO_2 before and after three cyclic tests.

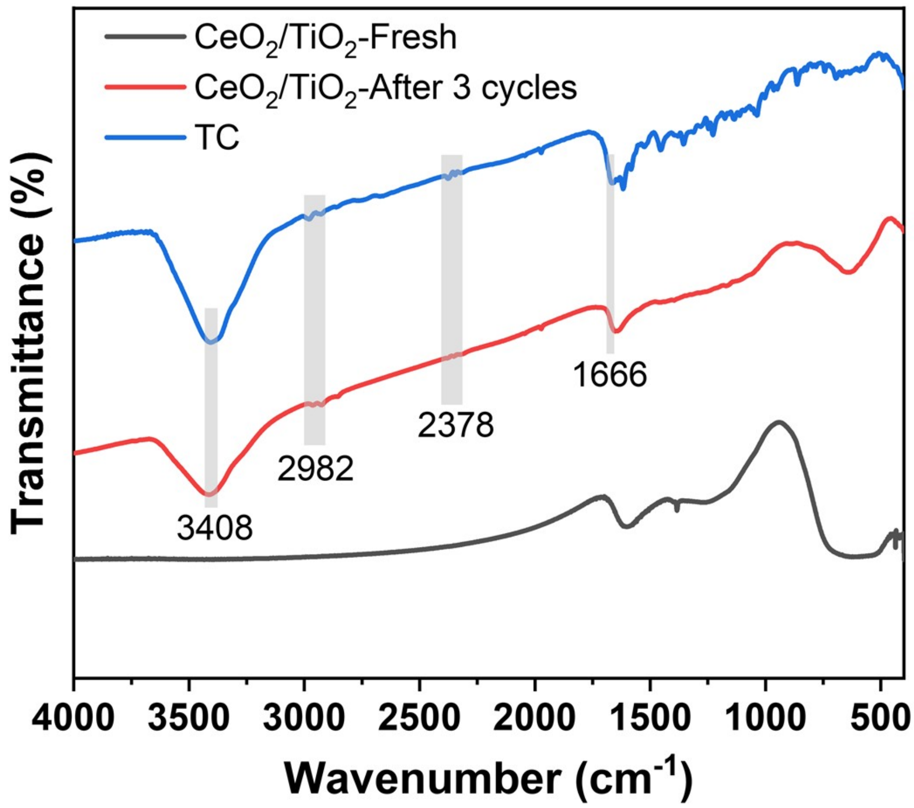

Fig. S11. FTIR spectra of the CeO_2/TiO_2 before and after three cyclic tests.

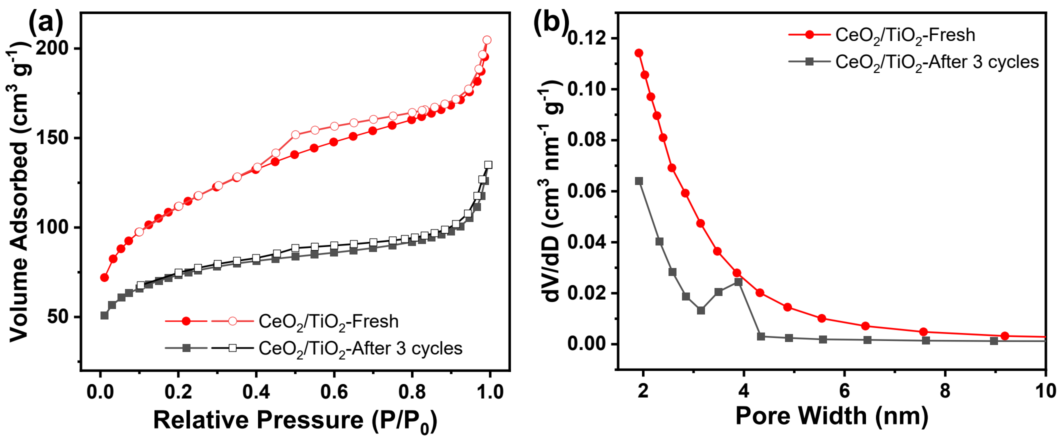

Fig. S12. (a) N_2 adsorption-desorption isotherms and (d) corresponding pore size distributions of the CeO_2/TiO_2 before and after three cyclic tests.

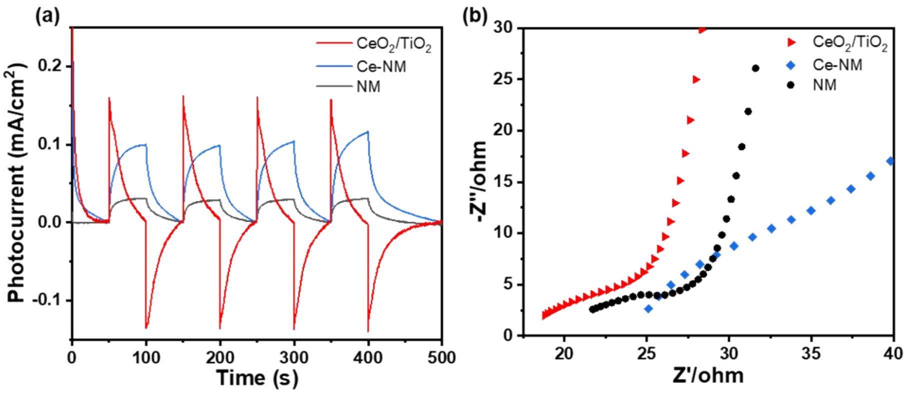

Fig. S13. (a) Transient photocurrent responses and (b) EIS spectra for NM, Ce-NM, and CeO_2/TiO_2 samples.

Table S1. Summary of the porous structures of the as-synthesized samples.

Entry	Samples	SSA ($m^2 \cdot g^{-1}$)	Pore volume ($cm^3\ g^{-1}$)	Average pore width (nm)
1	NM	1504.6	0.085	1.54
2	NM-derived TiO_2	340.4	0.176	3.10
3	CeO_2/TiO_2	400.6	0.258	3.16
4	Used CeO_2/TiO_2	254.4	0.132	3.16

Table S2. Summary of the adsorption capacities of the as-synthesized samples.

Entry	Sample	Equilibrium adsorption capacity (q_e, mg g^{-1})
1	NM	15.8
2	Ce-NM	28.3
3	CeO_2 nanoparticles	65.2
4	NM-derived TiO_2	69.6
5	m-CeO_2/TiO_2	80.2
6	CeO_2/TiO_2	146.4

Table S3. Linear forms of isotherm models.

Isothermal models	Names
$C_e/q_e = C_e/q_{max} + 1/q_{max}K_L$	Langmuir
$In\ q_e = ln\ K_F + 1/n\ ln\ C_e$	Freundlich
$q_e = B_T\ ln\ K_T + B_T\ ln\ C_e$	Temkin

q_{max} = maximum adsorption capacity, K_L = Langmuir constant, K_F = Freundlich constants, n = adsorption intensity (dimensionless) of the adsorbents, K_T (L mg^{-1}) = maximum binding energy constant, $B_T = RT/b_T$, R = the universal gas constant (8.314 J $mol^{-1}\cdot K$) and T = the temperature (K).

Table S4. Kinetic parameters for TC adsorption onto hierarchical mesoporous CeO_2/TiO_2.

Concentration (mg L^{-1})	Pseudo-first-order kinetic				Pseudo-second-order kinetic			
	$q_{e,exp}$ (mg g^{-1})	K_1 (min^{-1})	$q_{e,cal}$ (mg g^{-1})	R^2	$q_{e,exp}$ (mg g^{-1})	K_2 (min^{-1})	$q_{e,cal}$ (mg g^{-1})	R^2
10	47.997	0.105	10.875	0.78	47.997	0.083	48.054	1
25	84.479	0.017	30.186	0.69	84.479	0.002	85.251	0.999
50	150.07	0.017	40.577	0.58	150.07	0.002	150.83	0.999
100	120.52	0.015	36.08	0.57	120.52	0.002	121.07	0.998

Table S5. Calculated equilibrium constants for the adsorption of TC onto hierarchical mesoporous CeO_2/TiO_2.

c			Freundlich			Temkin		
q_{max}	k_L	R^2	n	k_f	R^2	Ln K_T	B_T	R^2
122.40	2.28	0.99	4.95	60.23	0.82	3.92	16.65	0.70

Table S6. Summary of the reaction conditions and performances of various recently reported Ce-contained, MOF-based, and typical composite oxides photocatalytic adsorbents.

Photocatalytic adsorbents	Dosage (g L^{-1})	TC (mg L^{-1})	Light sources	Time (h)	Degradation (%)	Ref.
Ce/Ti-MOFs	0.1	10	Full spectrum (500 W)	2	90.0	1
Ce-MOF/Bi/BiOCl	0.5	40	Full spectrum (300 W)	0.33	97.7	2
Ce/TiO_2@LDH	0.4	20	Full spectrum (300 W)	1.5	92.8	3
(Zr/Ce)UiO-66-NH_2@CN	0.2	10	λ = 420-780 nm	2	98.0	4
$Ce/FeTiO_3$	0.5	20	λ > 420 nm	2	97.5	5
MIL-125-$NH_2/CuFe_2O_4$	0.091	15	λ > 400 nm	1.25	93.0	6
Ti-MOF-400	0.3	10	λ > 420 nm	1	87.0	7
Fe_3O_4/g-C_3N_4/rGO	1	20	λ > 420 nm	1	86.7	8
WO_3/Bi_2MoO_6	0.6	20	λ > 420 nm	3	85.9	9
MOF@COF	10	50	λ > 420 nm	1	93.1	10
CeO_2/TiO_2	0.4	50	300 W Xe lamp, AM 1.5	1	93.1	This work

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