Electronic Supplementary Information

Construction of hierarchical-structured MgO-carbon nanocomposite from metal-organic complex for efficient CO_2 capture and organic pollutant removal

Ping Li,[a,b] Yunan Lin,[a,b] Ran Chen [a,b] and Wenqin Li [a,b]*

[a] *School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou 510275, Guangdong, P. R. China.*

[b] *Guangdong Provincial Key Laboratory of Environmental Pollution Control and Remediation Technology, Guangzhou 510275, P. R. China.*

E-mail: liping56@mail.sysu.edu.cn

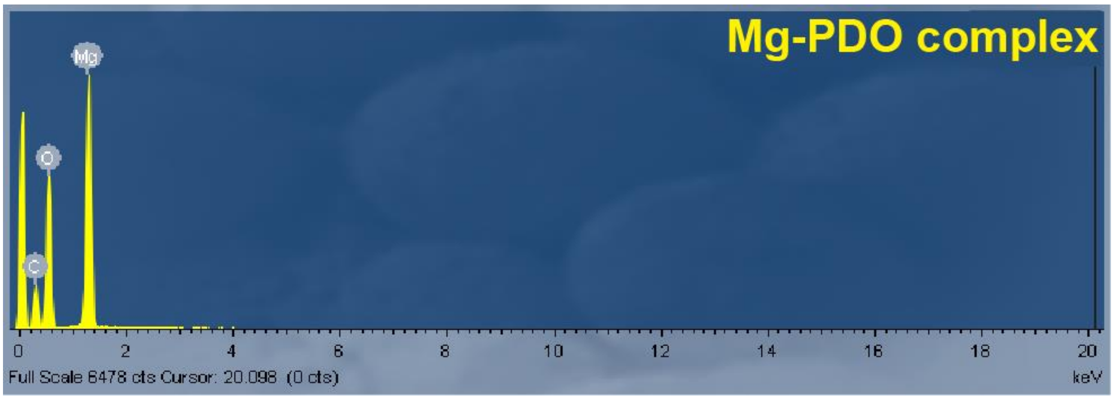

Figure S1. EDX pattern of Mg-PDO complex precursor.

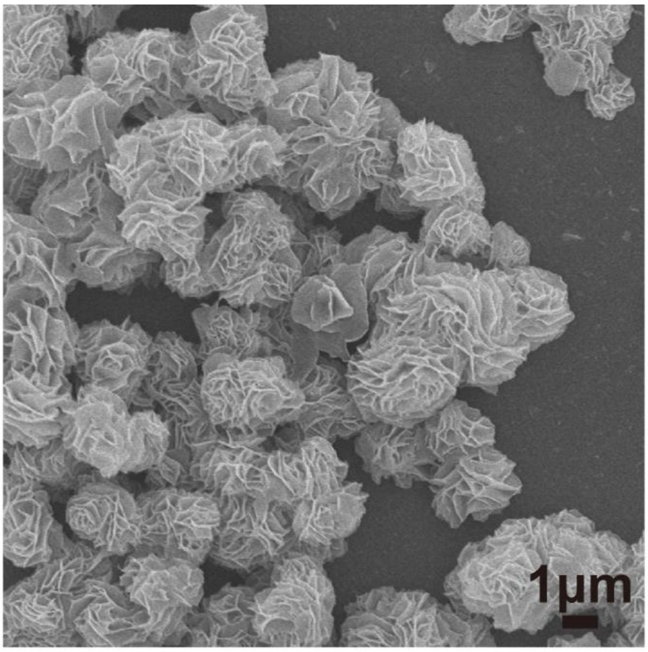

Figure S2. SEM image of MgO/C nanocomposite.

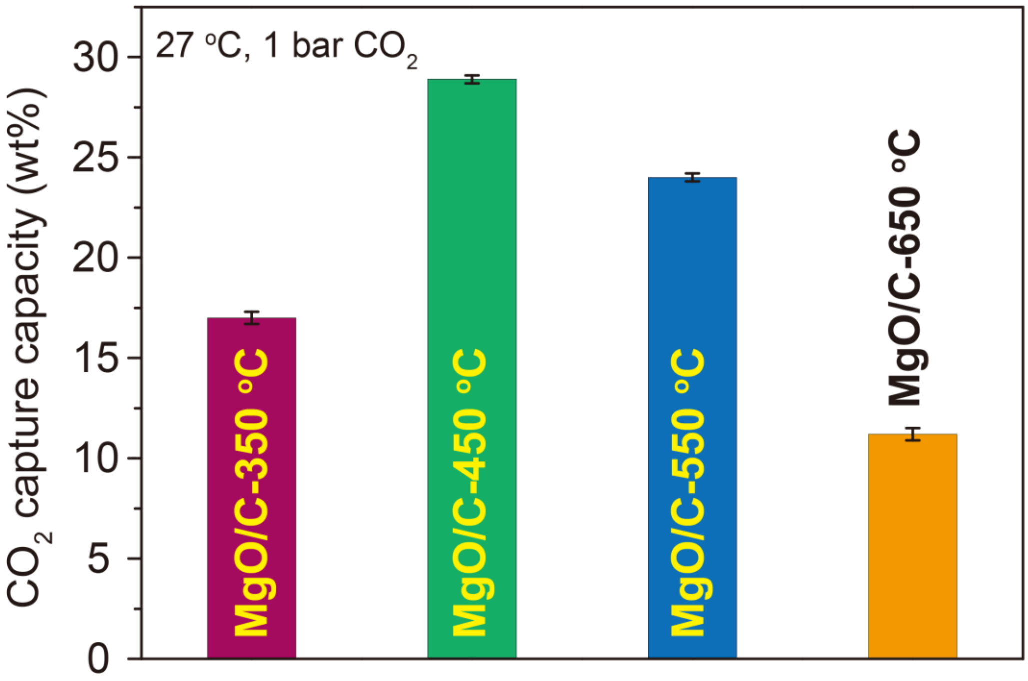

Figure S3. The CO_2 sorption capacities of MgO/C nanocomposites prepared by pyrolyzing at different temperature (e.g., 350, 450, 550, and 650 ℃). Testing condition: 27 ℃, 1 bar CO_2. Note that for the CO_2 capture performance test of the MgO/C-350 ℃, the sorbent was pretreated at 350 ℃ (rather than 400 ℃ applied in other cases) in a N_2 flow (50 mL/min) for 30 min to remove the moisture and CO_2 adsorbed from the atmosphere during storage and transportation.

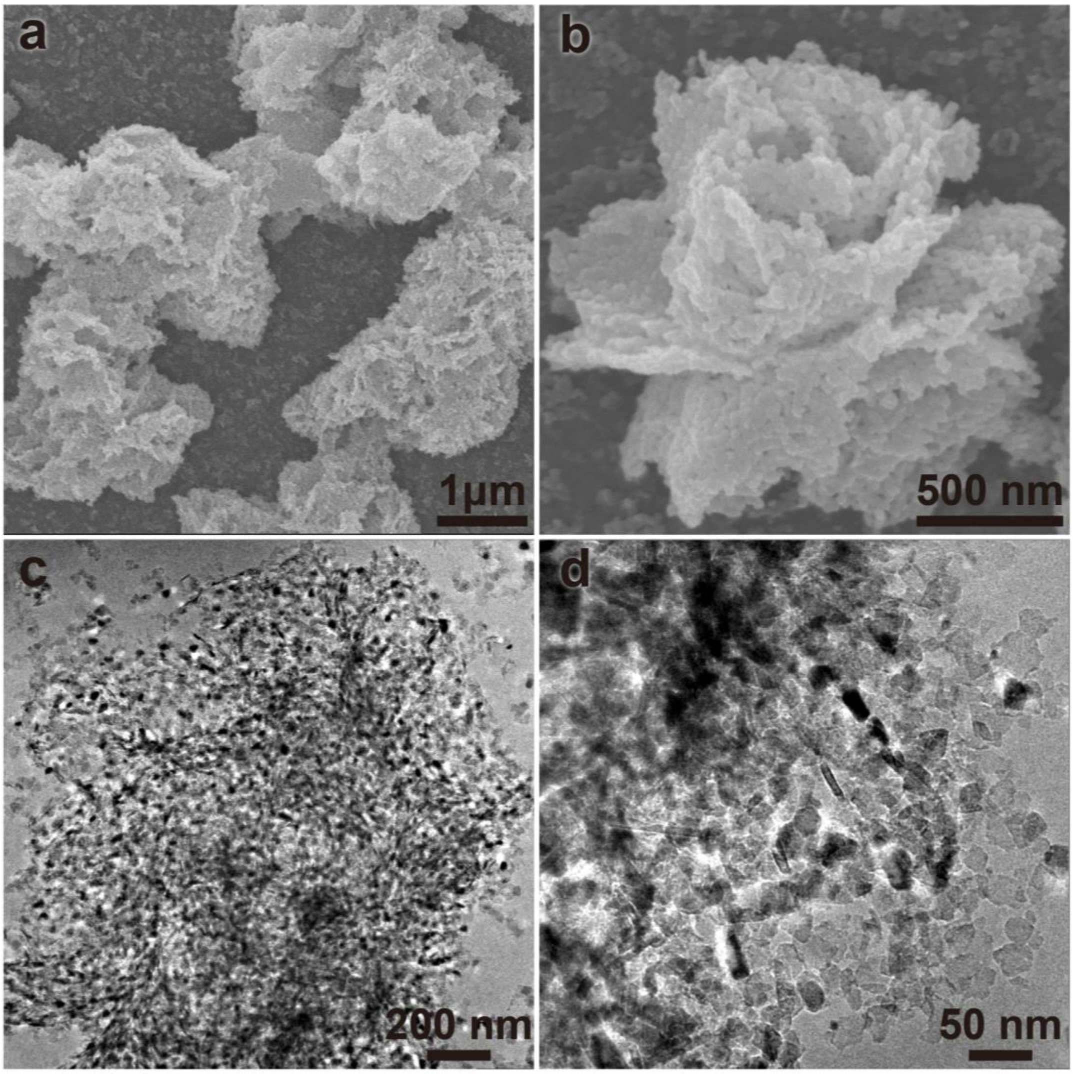

Figure S4. (a,b) SEM and (c,d) TEM images of the flower-like pure MgO control sample.

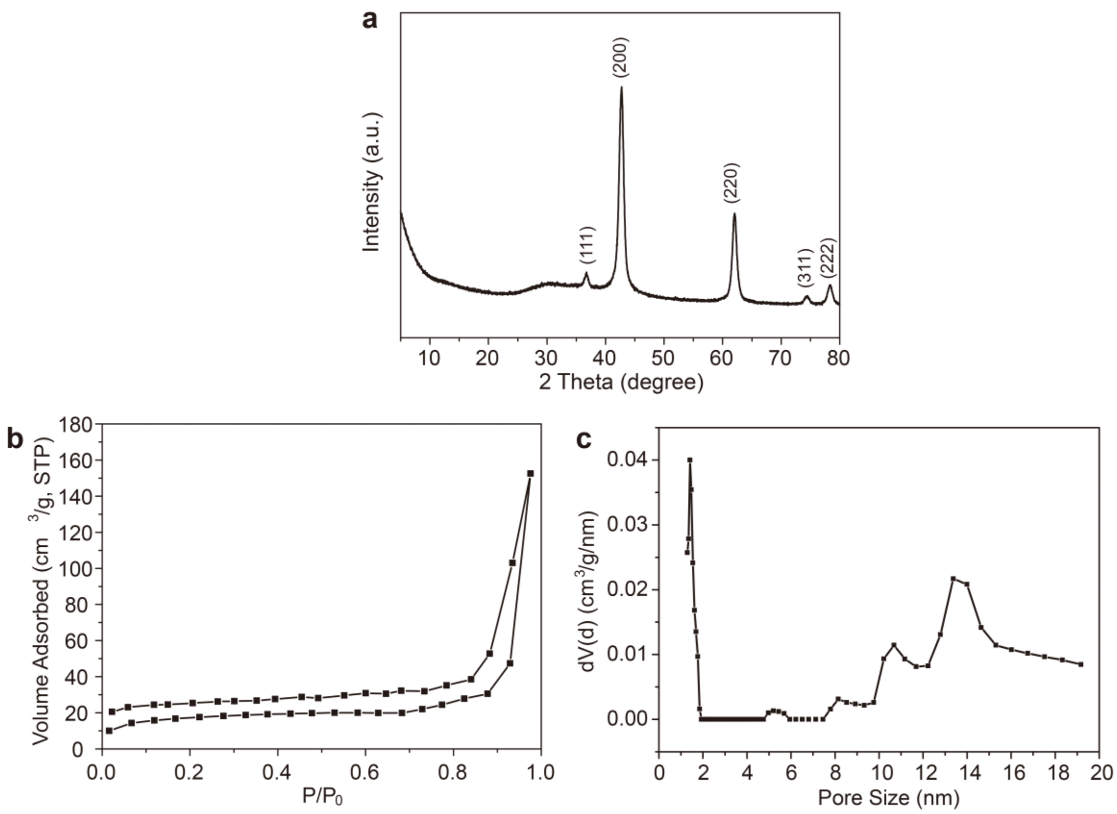

Figure S5. (a) XRD pattern, (b) N_2 adsorption–desorption isotherm, and (c) the corresponding NLDFT pore size distribution curve of the flower-like pure MgO control sample.

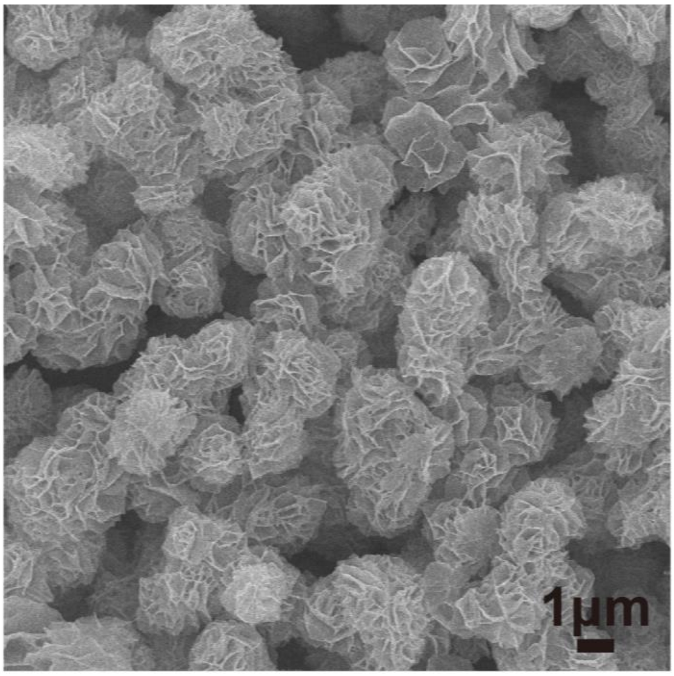

Figure S6. SEM image of the spent MgO/C nanocomposite after CO_2 cycling test.

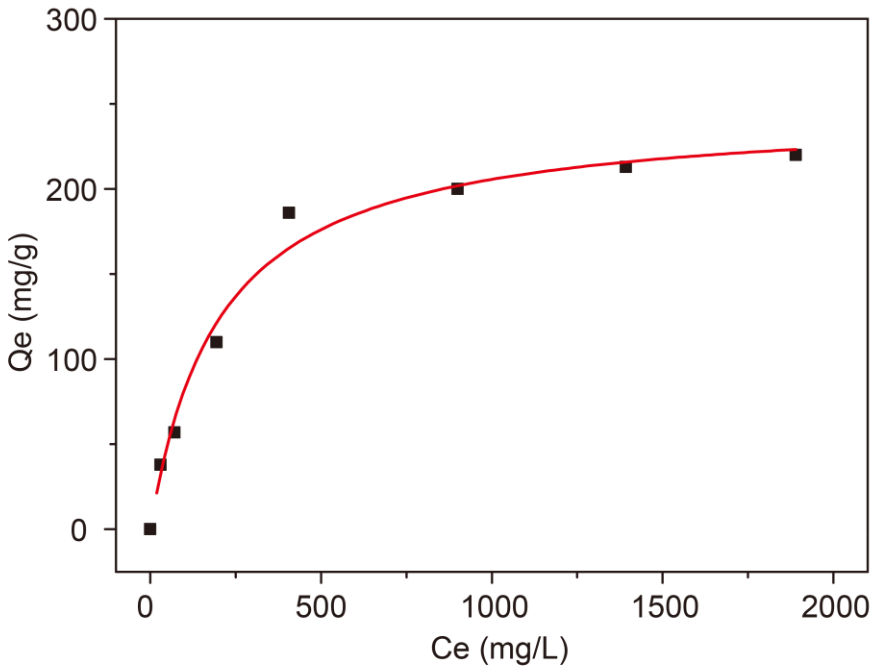

Figure S7. The adsorption isotherm of CR on the commerical MgO congrol sample. C_e (mg/L): the equilibrium concentration of CR; Q_e (mg/g): the amount of CR adsorbed per unit weight of the adsorbent at equilibrium.

Table S1. A summary of CO_2 capture capacities on different MgO-based adsorbents from the literature.

Adsorbent	Sorption temperature (℃)	Regeneration temperature (℃)	CO_2 partial pressure (bar)	CO_2 sorption capacity (wt%)	Ref.
Hierarchical MgO/C nanocomposite	**27**	**400**	**1**	**28.9**	**this work**
Foam-like MgO	25	600	1	*ca.* 12.0	1
Ordered mesoporous MgO/carbon spheres	25	---	1.2	11.88	2
MgO/activated carbon	30	400	1	*ca.* 9.9	3
Mesoporous carbon supported MgO	25	200	1	9.2	4
Mesoporous MgO	25	800	1	8.0	5
MgO/C	27	400	1	27.6-30.9	6
rGO@MgO/C	27	400	1	31.5	7
Carbon doped porous MgO-ZnO	25	400	1	4.21	8
Carbon doped porous MgO	25	400	1	5.31	
Porous pure MgO	25	400	1	6.12	
Mesoporous MgO-Al_2O_3	30	400	1	3.16-5.44	9
Mesoporous MgO-TiO_2	25	150	1	2.1	10
Mesoporous MgO	25	150	1	0.33	
Porous MgO	50	450	1	6.44-7.59	11
Mesoporous MgO-Al_2O_3	60	450	1 0.1	1.34 1.32	12
MgO-NP1	60	600	1	0.7	13
Multi-core MgO NPs@C	27	500	0.15	7.7	14
Nanoporous MgO/C	27	500	0.15	5.2-9.2	15
Mesoporous Mg−Zr oxides	30	400	0.1	3.56-5.63	16
Pure MgO	30	400	0.1	0.66	
MgO-Al_2O_3	60	350	0.13	4.3	17

Table S2. Comparisons of Congo red (CR) adsorption capacities on different adsorbents from the literature.

Adsorbent	S_{BET} (m^2/g)	Q_m (mg/g)	Ref.
Hierarchical MgO/C nanocomposite	**287**	**2937.8**	**this work**
MgO nanoplates	198	131.3	18
Mesoporous MgO architectures	94	689.7	19
Porous hierarchical MgO	148	2409	20
Hierarchical MgO–$MgFe_2O_4$ composites	--	498	21
Urchin-like α-FeOOH hollow spheres	96.9	275	22
Multishelled Co_3O_4-Fe_3O_4 hollow spheres	130	125	23
α-Fe/Fe_3O_4 nanocomposite	67.6	1297	24
Hollow nestlike α-Fe_2O_3 nanostructure	152.4	160	25
Mesoporous Fe_2O_3	111	53	26
α-FeOOH hierarchical nanostructures	239	239	27
Magnetite nanochain	43.5	67	28
Hierarchical NiO nanospheres	222	440	29
Hierarchical porous NiO architectures	58.3	223.8	30
Hierarchical NiO nanosheets	201	151.7	31
NiO–Al_2O_3 nanocomposite	157	357	32
hierarchical calcined Ni/Mg/Al LDHs	179	1250	33
FeTiOx microspheres	152.3	723.8	34
Hierarchical porous ZnO	57	334	35
Boehmite hollow core–shell microspheres	269	111.3	36
Porous $MgAl_2O_4$ spinel	127.9	845	37
γ-AlO(OH)/MgAl-LDH/C	288	447	38
Spindle-like γ-Al_2O_3	149	176.7	39
Nanorod-like mesoporous γ-Al_2O_3	158	83.8	40
Layered-lanthanum nanowires	146.3	470	41
Bacterial cellulose derived purifier	--	694	42
Porous boron nitride nanosheets	1427	782	43
hybrid porous polymer	1741	1715	44
Na-Bentonite (Clay materials)	--	35.84	45
Kaolin (Clay materials)	--	5.44	45

Zeolite (Clay materials)	--	3.77	[45]
Activated carbon	492	~200	[46]

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