Electronic Supplementary Information (ESI)

MnO_2 Nanostructures with Three-dimensional (3D) Morphology Replicated from Diatoms for High-Performance Supercapacitors

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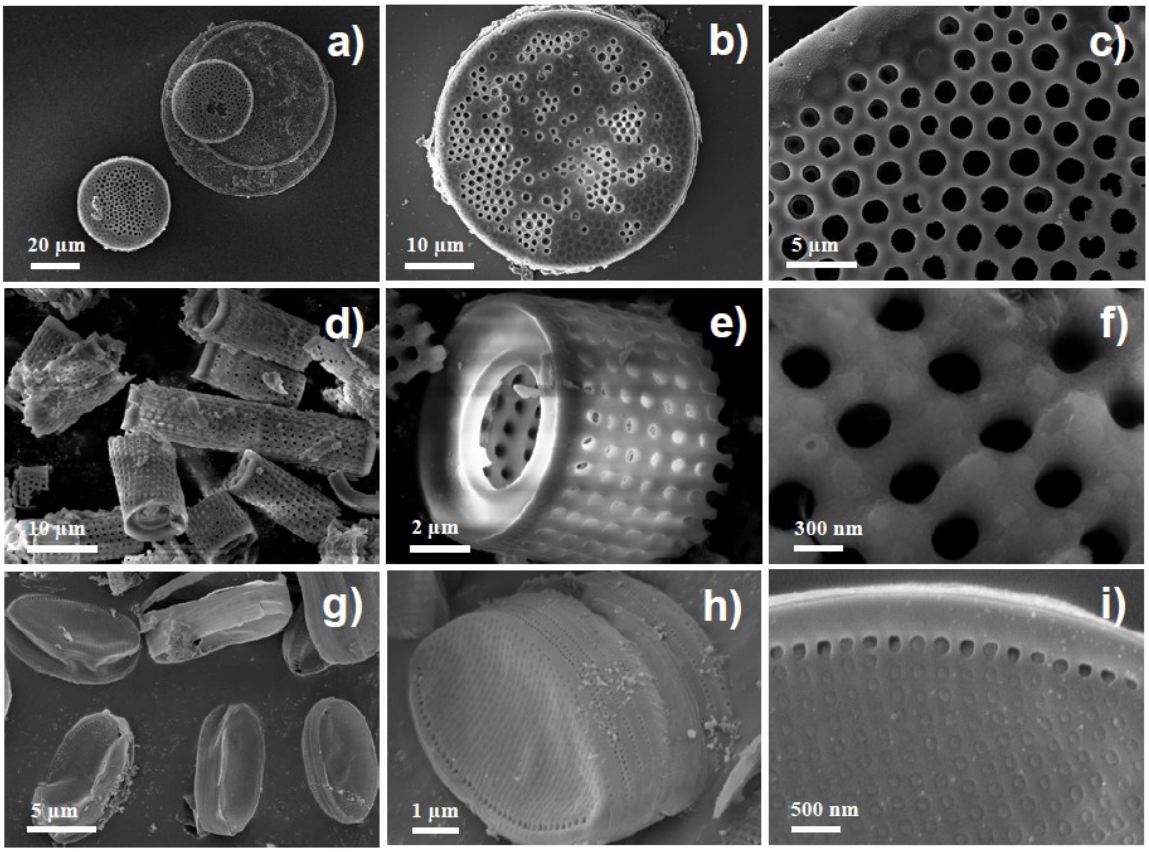
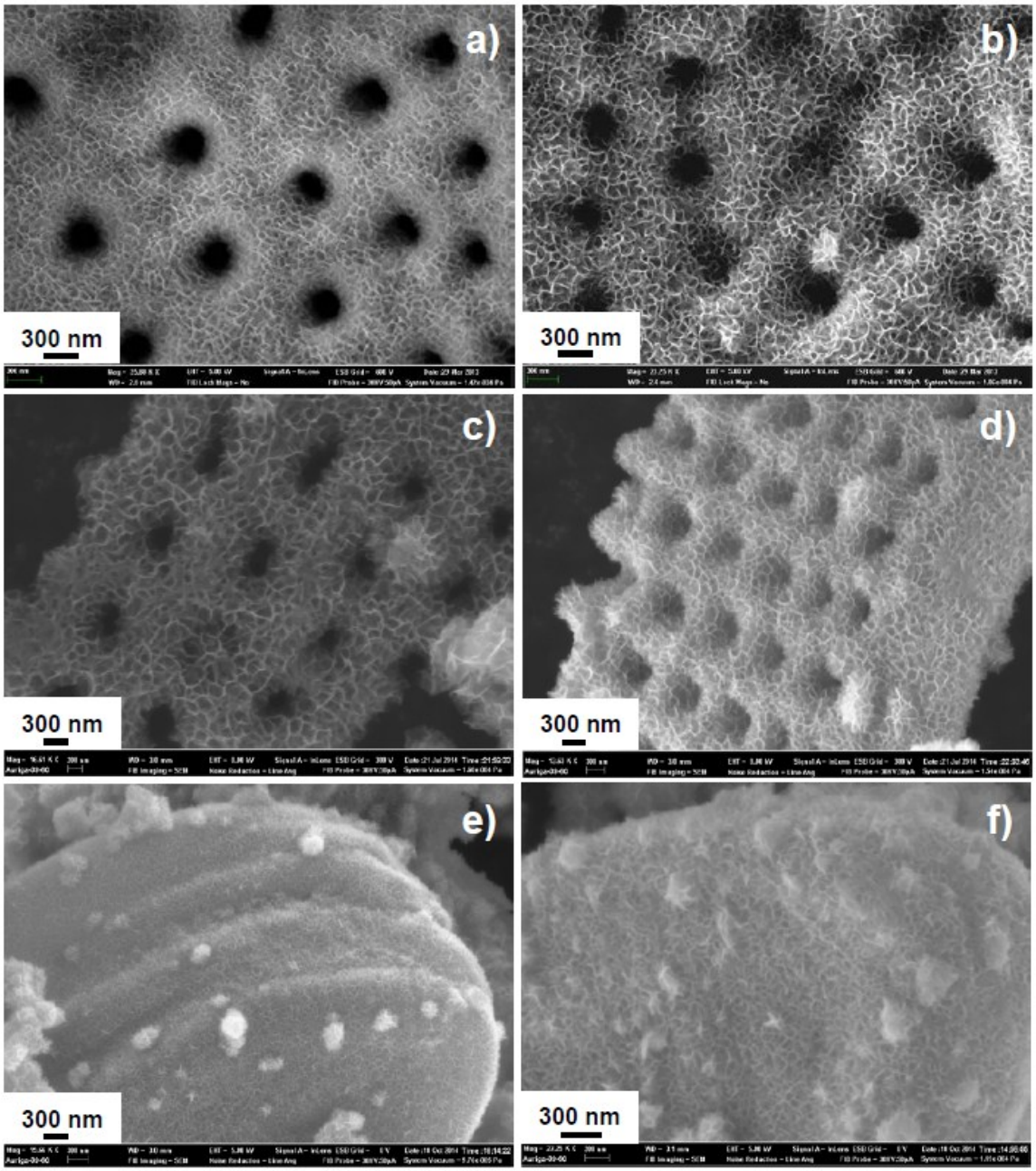
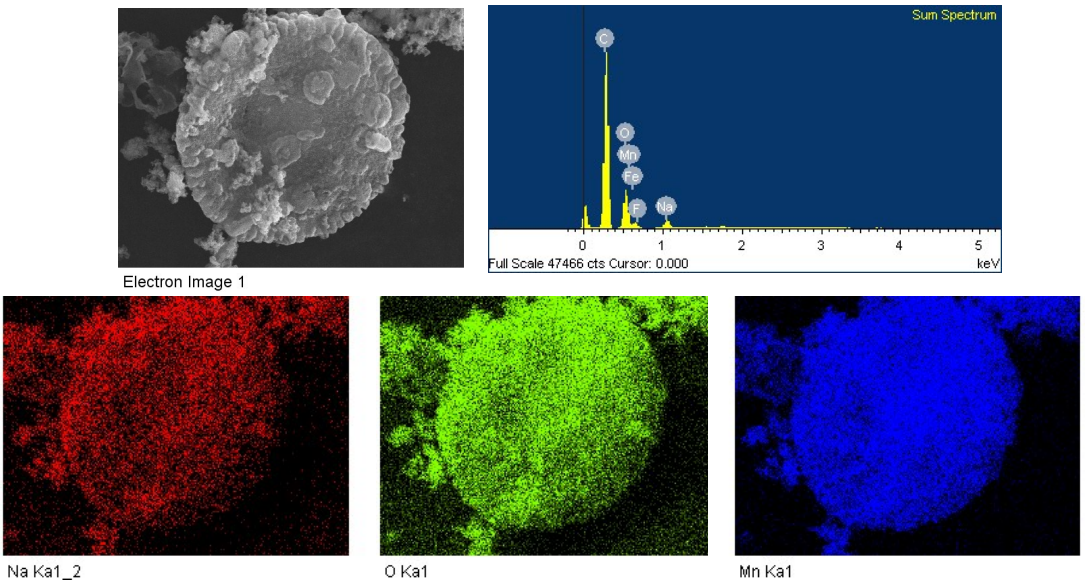


SI-1 SEM images of diatom structure obtained from three species with different morphologies: (a, b, c), *Coscinodiscus* diatoms from fossilized DE, (d, e, f) *Melosira* diatoms from fresh water fossilised DE and (g, h, i), *Navicula* from cultured diatoms



SI-2 SEM images of diatomite @ MnO2 with different morphologies prepared using different diatoms: (a, b), *Coscinodiscus* (c, d), *Melosira* and (e, f), *Navicula*



SI-3 the scanning electron microscope (SEM) images and the corresponding energy dispersive X-ray spectrometry (EDS) elemental mapping of the MnO2 structure showing the uniform distribution of O, K and Mn elements. images of diatomite @ MnO2 with different morphologies prepared using different diatoms: (a, b), *Coscinodiscus* (c, d), *Melosira* and (e, f), *Navicula*

Table S1 The percentages of MnO_2 in diatoms @ MnO_2.

Samples	M_1	M_2	*percentage*
Coscinodiscus-diatom@MnO_2	40 mg	22.4 mg	56.0%
Melosira-diatom@MnO_2	40 mg	27.7 mg	69.25%
Navicula-diatom@MnO_2	40 mg	31.3 mg	78.25%

Table S2 BJH Adsorption Pore Distribution of MnO2 patterns by replica molding from diatom with different morphologies: (a) Melosira-diatom, (b) Coscinodiscus-diatom, and (c) Navicula-diatom, respectively.

(a) Pore Diameter Range (nm) Melosira-diatom	*Average Diameter (nm)*	*Incremental Pore Volume (cm^3/g)*
481.2 - 47.8	51.6	0.136963
47.8 - 27.3	32.1	0.034350
27.3 - 18.9	21.5	0.016338
18.9 - 14.4	16.0	0.008749
14.4 - 11.7	12.7	0.005078
11.7 - 9.8	10.6	0.003094
9.8 - 8.4	9.0	0.001838
8.4 - 7.4	7.8	0.001228
7.4 - 6.6	6.9	0.000687
6.6 - 5.9	6.2	0.000342
5.9 - 5.3	5.6	0.000237
5.3 - 4.9	5.1	0.000005
4.9 - 1.7	1.7	0.000125

(b) Pore Diameter Range (nm) Coscinodiscus-diatom	*Average Diameter (nm)*	*Incremental Pore Volume (cm^3/g)*
169.1 - 46.8	54.9	0.075436
46.8 - 26.8	31.5	0.034028
26.8 - 18.7	21.3	0.015838
18.7 - 14.4	16.0	0.008481
14.4 - 11.6	12.7	0.005410
11.6 - 9.8	10.5	0.003436

9.8 - 8.5	9.0	0.002299
8.5 - 7.4	7.9	0.001717
7.4 - 6.6	7.0	0.001037
6.6 - 5.9	6.2	0.000759
5.9 - 5.4	5.6	0.000541
5.4 – 4.9	5.1	0.000319
4.9 - 4.5	4.7	0.000206
4.5 - 4.2	4.3	0.000077
4.2 - 3.6	3.7	0.000133
3.6 - 3.1	3.2	0.000075
3.1 - 2.9	3.0	0.000043
2.9 - 2.7	2.8	0.000010
2.7 - 2.5	2.6	0.000145
2.5 - 2.2	2.2	0.000080
2.2 - 2.0	2.1	0.000275
2.0 - 1.8	1.9	0.000325
1.8 - 1.7	1.7	0.000596

(c) Pore Diameter Range (nm) Navicula-diatom	*Average Diameter (nm)*	*Incremental Pore Volume (cm^3/g)*
168.6 - 48.0	56.5	0.077591
48.0 - 27.1	31.9	0.031409
27.1 - 18.7	21.3	0.014995
18.7 - 14.4	15.9	0.007878
14.4 - 11.7	12.7	0.004759
11.7 - 9.8	10.6	0.002992
9.8 - 8.5	9.0	0.001886

8.5 - 7.4	7.9	0.001146
7.4 - 6.6	7.0	0.000739
6.6 - 5.9	6.2	0.000279
5.9 - 5.4	5.6	0.000122
5.4 – 4.9	5.1	0.000148
4.9 - 3.3	3.4	0.000040
3.3- 3.1	3.2	0.000117
3.1 - 2.9	3.0	0.000263
2.9 - 2.7	2.8	0.000107
2.7 - 2.5	2.6	0.000236
2.5 - 2.3	2.4	0.000194
2.3 - 2.2	2.2	0.000270
2.2 - 2.0	2.1	0.000305
2.0 - 1.8	1.9	0.000378
1.8 - 1.7	1.7	0.000476

Table S3 Comparison of specific capacitances between the reported MnO_2 electrodes and the present work. All values are measured using the three-electrode system.

Samples	*Cs* (F g^{-1})	Electrolyte	Test condition	References
Hollow MnO_2 microsphere	90	1 M Na_2SO_4	10 mV s^{-1}	1
Amorphous MnO_2	110	2 M NaCl	5 mV s^{-1}	2
α-MnO_2 hollow urchins	123	0.5 M Na_2SO_4	2 mV s^{-1}	3
Ambigel MnO_2	130	2 M NaCl	5 mV s^{-1}	4
α-MnO_2 nanorod	152	1 M Na_2SO_4	5 mV s^{-1}	5
α-MnO_2 hollow sphere	167	1 M Na_2SO_4	2.5 mA cm^{-2}	6
Birnessite hollow MnO_2	169	1 M Na_2SO_4	0.25 A g^{-1}	7
MnO_2 spherical particle	170.8	0.5 M K_2SO_4	0.5 A g^{-1}	8
MnO_2 nanowire	176	1 M Na_2SO_4	5 mV s^{-1}	9
MnO_2 nanosheet	182	0.1 M Na_2SO_4	0.1 A g^{-1}	10
MnO_2 microsphere	190	1 M Na_2SO_4	0.5 A g^{-1}	11
α-MnO_2 sphere	200	0.25 M Na_2SO_4	1 A g^{-1}	12
Amorphous $MnO_2 \cdot nH_2O$	200	2 M KCl	5 mV s^{-1}	13
MnO_2 nanosheet array	201	1 M Na_2SO_4	1 A g^{-1}	14
MnO_2-pillared layered MnO_2	206	1 M Na_2SO_4	5 mV s^{-1}	15

Birnessite MnO_2 nanosphere	210	1 M Na_2SO_4	1 A g^{-1}	16
Mesoporous MnO_2	221	1 M Na_2SO_4	5 mV s^{-1}	17
Core-corona MnO_2	226	0.5 M Li_2SO_4	0.2 A g^{-1}	18
γ-MnO_2 film	240	0.1 M Na_2SO_4	1 mA cm^{-2}	19
α-MnO_2 nanorod	245	1 M KOH	1 A g^{-1}	20
Amorphous MnO_2 particle	251	1 M Na_2SO_4	2 mV s^{-1}	21
α-MnO_2 spherical-like particle	258.7	1 M Na_2SO_4	0.1 A g^{-1}	22
Layered δ-MnO_2	265	1 M Na_2SO_4	5 mV s^{-1}	23
Mesoporous α-MnO_2 network	283	1 M Na_2SO_4	2 mV s^{-1}	24
Mesoporous MnO_2 nanoparticle	284.2	1 M Li_2SO_4	1 mV s^{-1}	25
α-MnO_2 spherical aggregate	297	0.1 M Na_2SO_4	20 mV s^{-1}	26
MnO_2 nanowire	300	1 M Na_2SO_4	5 mV s^{-1}	27
Nanoscale MnO_2	305	1 M Na_2SO_4	2 mV s^{-1}	28
MnO_2 tubular nanostructure	315	1 M Na_2SO_4	0.2 A g^{-1}	29
α-MnO_2 nanoflake film	328	1 M Na_2SO_4	5 mV s^{-1}	30
α-MnO_2 ultralong nanowire	345	0.5 M Na_2SO_4	1 A g^{-1}	31
MnO_2 nanoflower	347	1 M Na_2SO_4	5 mV s^{-1}	32
MnO_2 hollow structure	366	1 M Na_2SO_4	5 mV s^{-1}	33
Clew-like MnO_2 particle	404.1	1 M Na_2SO_4	2 mV s^{-1}	34
MnO_2 nanofiber	412	0.1 M Na_2SO_4	2 mV s^{-1}	35
Melosira-type MnO_2	371.2	1 M Na_2SO_4	0.5 A g^{-1}	This work

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