Electronic Supplementary Information (ESI)

Soft Templated Mesoporous Manganese Oxide/Carbon Nanotube Composite via Interfacial Surfactant Assembly

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Supporting Information

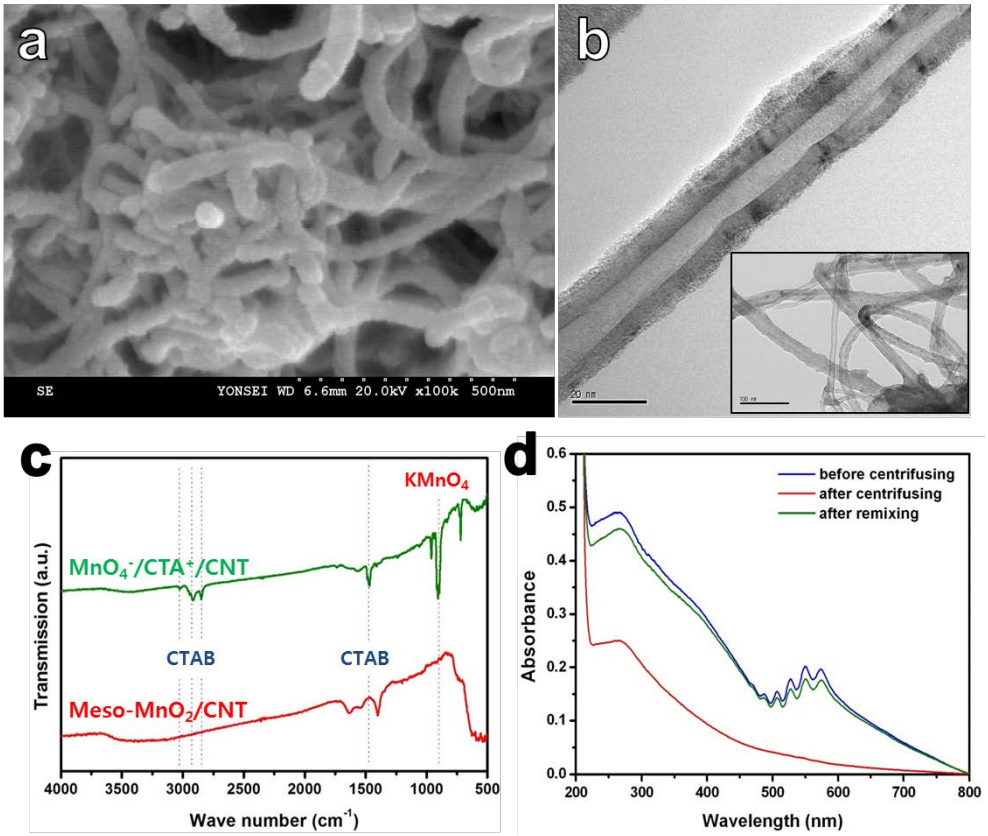

Fig. S1 (a) SEM and (b) TEM image of $MnO_4^-/CTA^+/CNT$; (c) FT-IR spectra of $MnO_4^-/CTA^+/CNT$ and the meso-MnO_2/CNT composite and (d) UV-vis spectra of the sampled $MnO_4^-/CTA^+/CNT$ solution.

Fig. S1a and b shows SEM and TEM images of $MnO_4^-/CTA^+/CNT$. As shown in SEM and TEM images, the thin coating layer on CNT surface was observed. Therefore, it is clear that the CNTs were uniformly coated with MnO_4^-/CTA^+, while the 3D entangled porous structure of the CNTs was preserved. Fig. S1c shows the FT-IR spectra of $MnO_4^-/CTA^+/CNT$ and the mesoporous MnO_2/CNT composite. The characteristic signature of methylene ($–CH_2$) and methyl ($–CH_3$) C–H stretching vibrations from the surfactant microphase can be seen in the 2700–3100 cm^{-1} region in the spectrum of the $MnO_4^-/CTA^+/CNT$.[1] The strong peak maxima were assigned to the $–CH_2$ symmetric and antisymmetric stretching modes; whereas, the

overlapping contributions were assigned to the $-CH_3$ symmetric and antisymmetric stretching modes.[1] The peaks around 750–800 cm^{-1} were attributed to residual $KMnO_4$.

In contrast, these peaks were noticeably absent in the spectrum of the mesoporous MnO_2/CNT composite. UV-vis spectroscopy was used to observe changes in the concentration of MnO_4^- ions in the sampled $MnO_4^-/CTA^+/CNT$ solution. The sampled solution before centrifuging gave characteristic absorption bands of MnO_4^- at wavelengths of 525, 545, and 570 nm. However, these bands were completely absent after centrifuging, indicating that all of the MnO_4^- ions assembled with CTA^+/CNT. After remixing the centrifuged solution, the absorbance was recovered, suggesting the restoration of the homogeneous $MnO_4^-/CTA^+/CNT$ suspension.

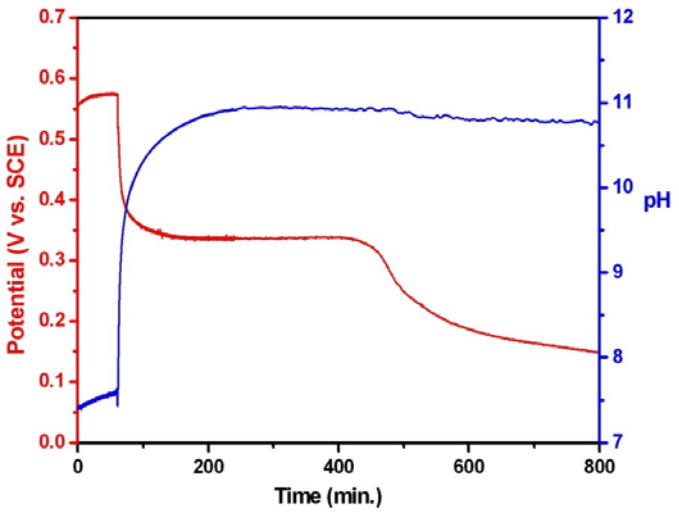

Fig. S2 Electrode potential (E) and pH vs. time curves of meso-MnO_2 measured during the reduction of MnO_4^- ions.

Fig. S2 shows the change in the E and pH of the solution with time during the synthesis of the meso-MnO_2. The changes in these parameters were very similar to those evident in regions c–f of the meso-MnO_2/CNT shown in Fig. 1a.

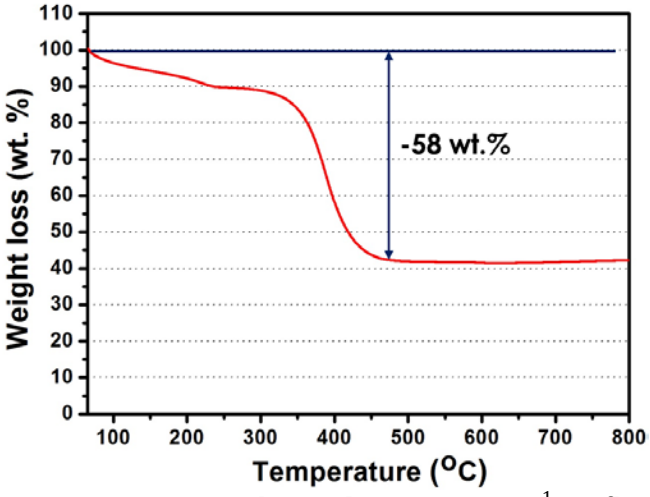

Fig. S3 TGA plots of meso-MnO_2/CNT obtained at 10 mL min^{-1} air flow and a heating rate of 10°C min^{-1}.

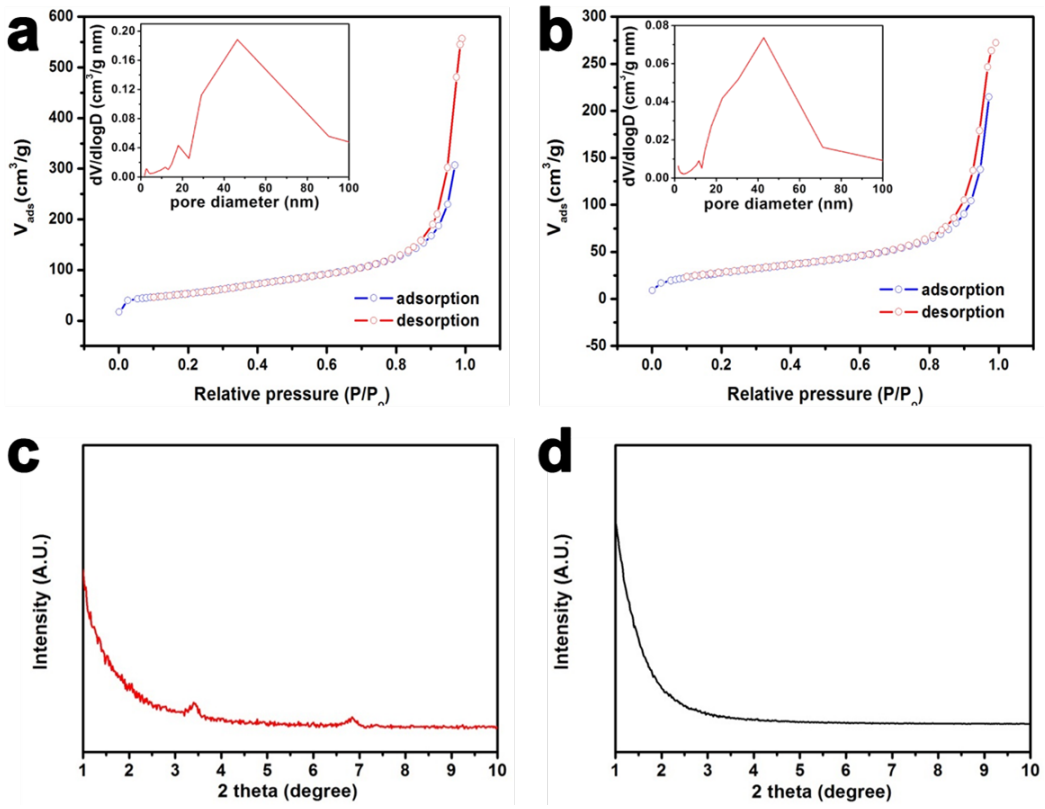

Fig. S4 N_2 adsorption–desorption isotherms of (a) CNTs, (b) non-porous MnO_2/CNT and low-angle XRD patterns of (c) meso-MnO_2/CNT, (d) CNT.

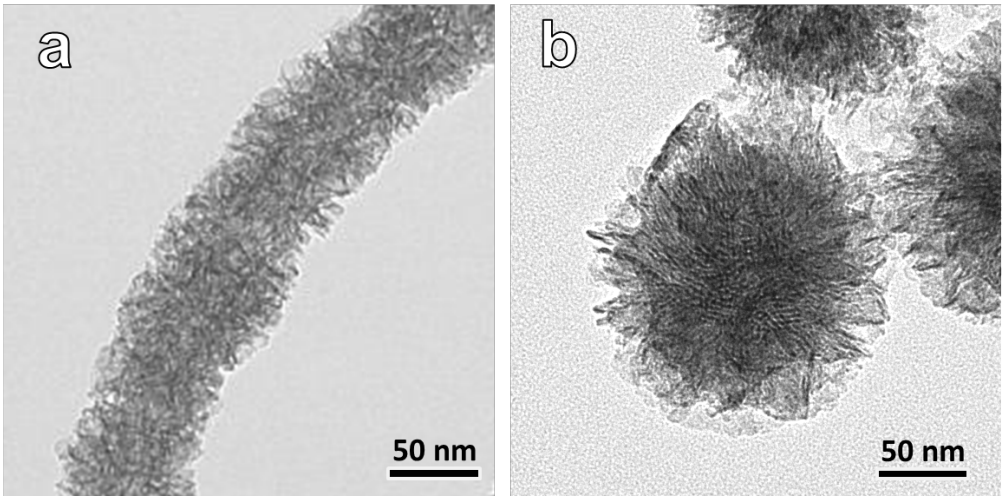

Fig. S5 TEM images of (a) the meso-MnO_2/CNT composite and (b) meso-MnO_2 after surfactant removal.

Fig. S5 shows TEM images of the mesoporous MnO_2/CNT composite and mesoporous MnO_2 after surfactant removal. After surfactant removal, the mesoporous MnO_2/CNT composite and mesoporous MnO_2 exhibit disordered mesoporous structure caused by partial collapse of the mesoporous domains.

Table S1. Specific capacitance values for the meso-MnO_2/CNT composite and meso-MnO_2 at different scan rates.

	10 mVs^{-1}	20 mVs^{-1}	50 mVs^{-1}	100 mVs^{-1}	200 mVs^{-1}	500 mVs^{-1}	1000 mVs^{-1}
Mesoporous MnO_2/CNT (based on composite mass)	220 Fg^{-1}	213 Fg^{-1}	201 Fg^{-1}	188 Fg^{-1}	170 Fg^{-1}	139 Fg^{-1}	112 Fg^{-1}
	(100 %)	(97 %)	(91 %)	(85 %)	(77 %)	(63 %)	(51 %)
Mesoporous MnO_2/CNT (based on MnO_2 mass)	512 Fg^{-1}	495 Fg^{-1}	467 Fg^{-1}	437 Fg^{-1}	395 Fg^{-1}	323 Fg^{-1}	260 Fg^{-1}
	(100 %)	(97 %)	(91 %)	(85 %)	(77 %)	(63 %)	(51 %)
Mesoporous MnO_2	125 Fg^{-1}	105 Fg^{-1}	83 Fg^{-1}	71 Fg^{-1}	60 Fg^{-1}	48 Fg^{-1}	40 Fg^{-1}
	(100 %)	(84 %)	(67 %)	(57 %)	(48 %)	(39 %)	(32 %)
CNTs	111 Fg^{-1}	100 Fg^{-1}	93 Fg^{-1}	86 Fg^{-1}	77 Fg^{-1}	69 Fg^{-1}	62 Fg^{-1}
	(100 %)	(90 %)	(83 %)	(77 %)	(69 %)	(62 %)	(56 %)

References

1. T. Clark, J. D. Ruiz, H. Y. Fan, C. J. Brinker, B. I. Swanson and A. N. Parikh, *Chemistry of Materials*, 2000, **12**, 3879-3884.