Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supplement Information

Preparation of hierarchical C@MoS_2@C sandwiched hollow spheres for Lithium ion batteries

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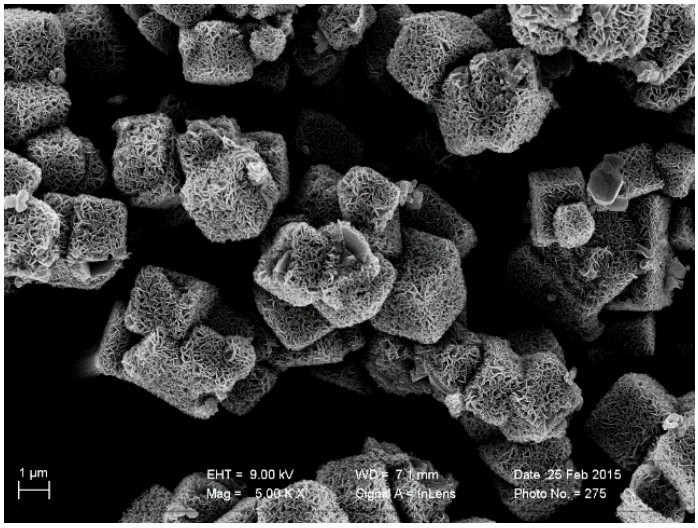

Fig. S1 SEM image of the MoS_2/MnS hybrid cubes synthesized without PDA protection layer.

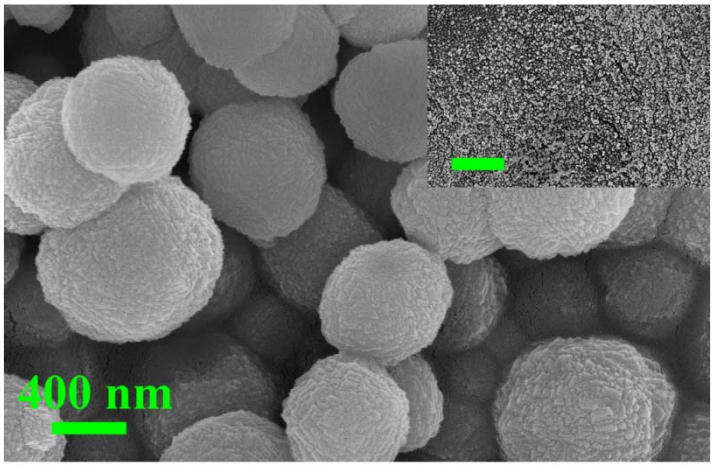

Fig. S2 SEM image of $MnCO_3$ nanospheres. The inset is with obtained with low magnification. The scale bar in the inset is 2 µm.

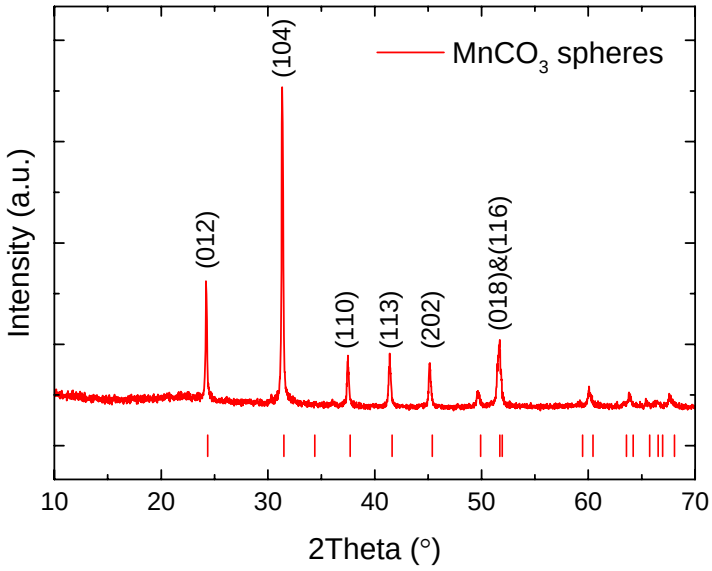

Fig. S3 XRD pattern of $MnCO_3$ nanospheres. Ticks mark the standard pattern of $MnCO_3$.

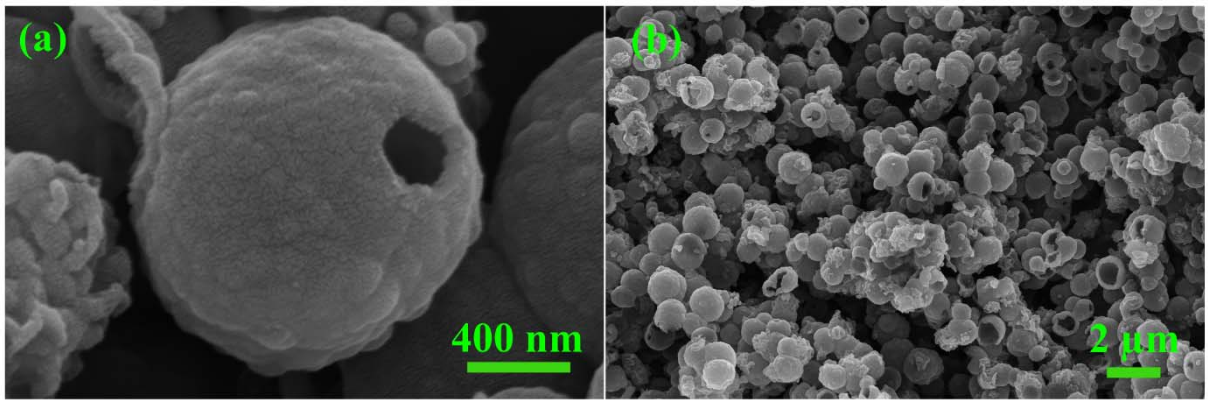

Fig. S4 SEM images of PDA-derived C hollow spheres.

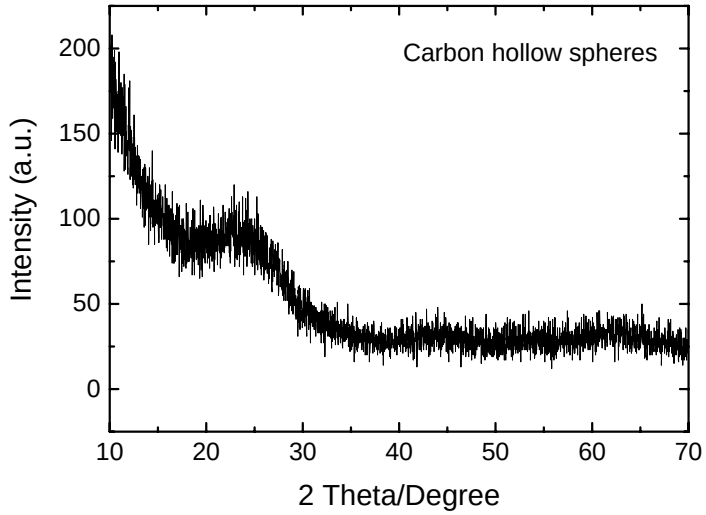

Fig. S5 XRD pattern of the PDA-derived C hollow spheres.

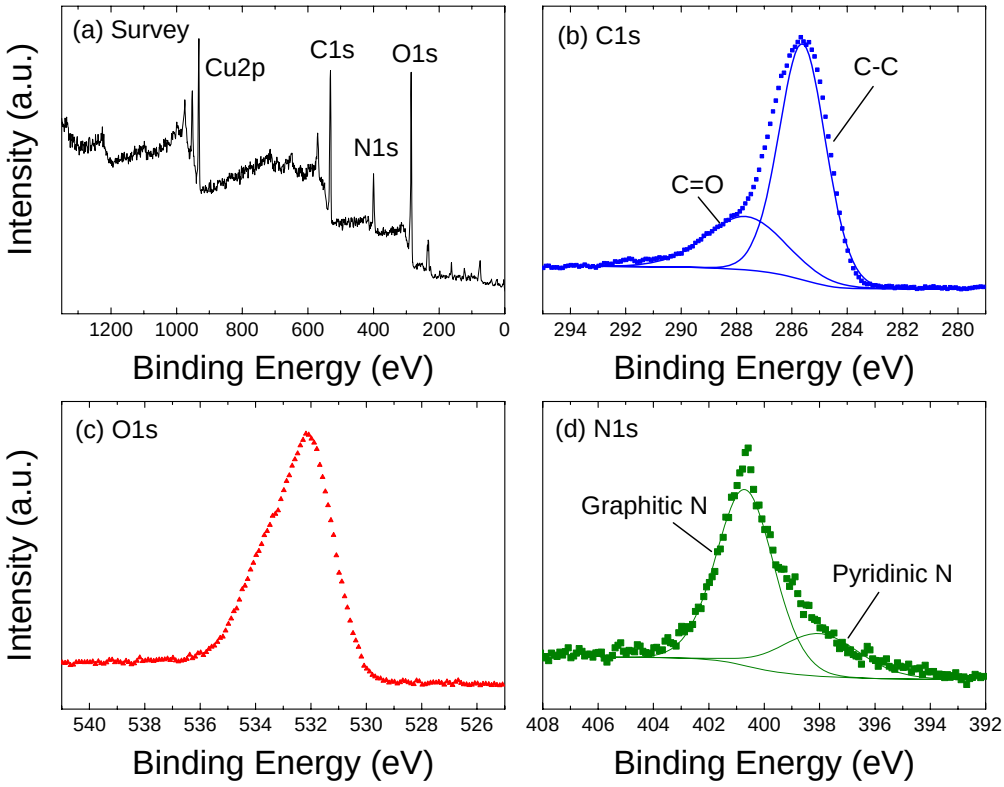

Fig. S6 XPS measurement on PDA-derived C hollow spheres: (a) survey scan, (b)~(d) high resolution scan of C1s, O1s, and N1s.

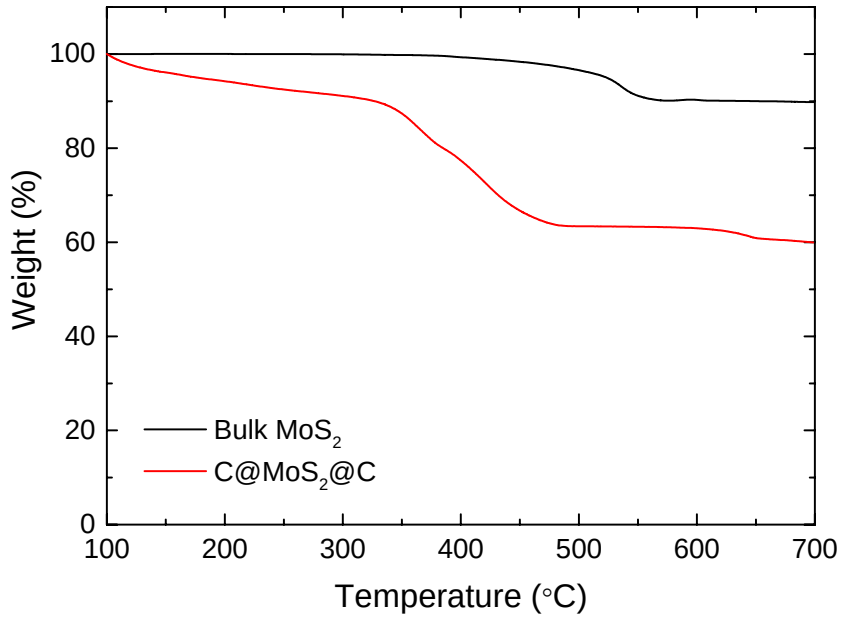

Fig. S7 TGA curves of bulk MoS_2 (purchased from Sigma-Aldrich Company) and C@MoS_2@C. In the C@MoS_2@C curve, the gradual slop below 300 °C attributes to the bound water while the steep slope in the 300-500 °C range comes from the oxidation of MoS_2 to MoO_3.

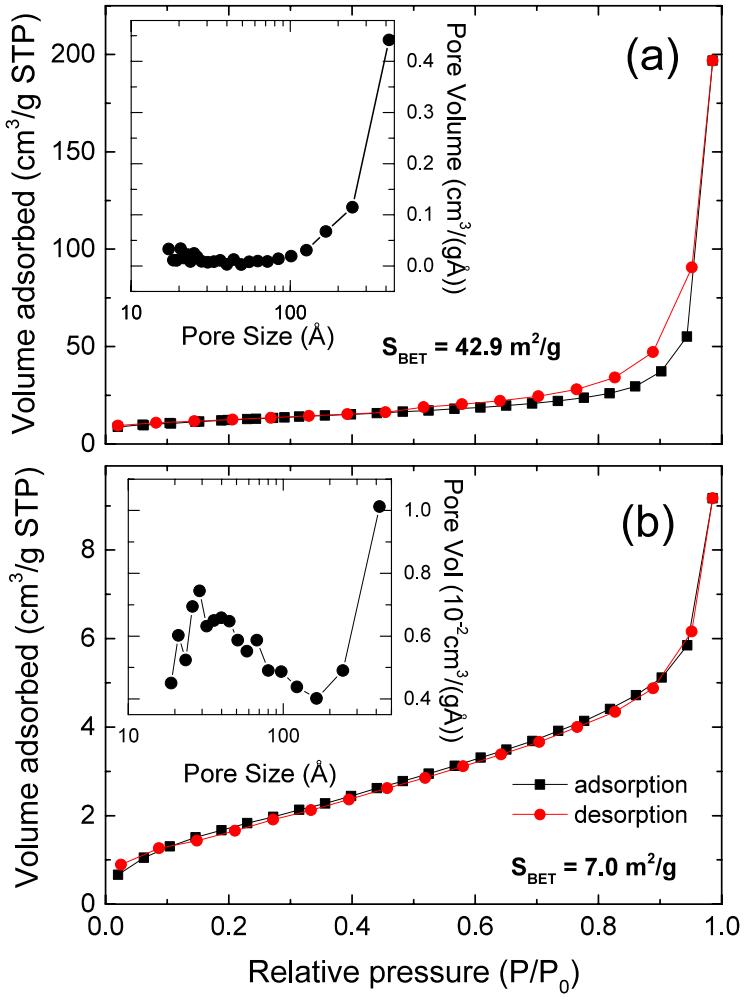

Fig. S8 N_2 adsorption-desorption isotherms of C@MoS_2@C (a) and of pure MoS_2 assembly (b). Insets show the pore distribution.

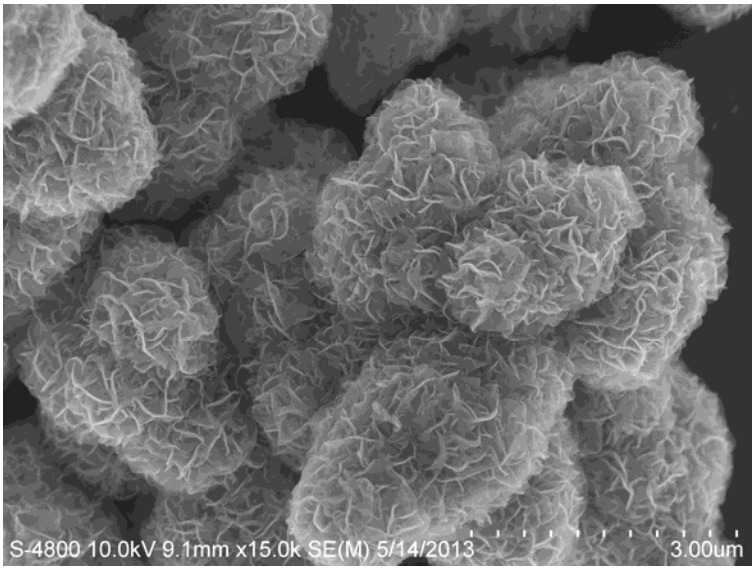

Fig. S9 SEM image of the pure MoS_2 assembly obtained at the same hydrothermal condition without template.

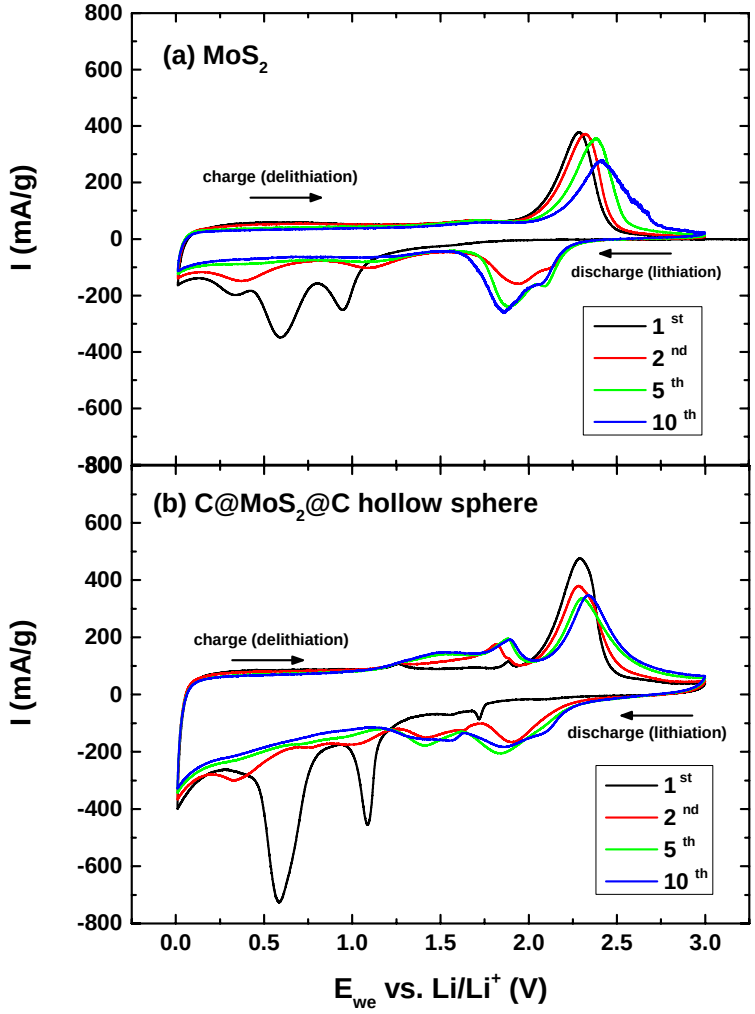

Fig. S10 Cyclic voltammograms of pure MoS_2 assembly and of the C@MoS_2@C hollow spheres at selected cycles.

Sample	C-rate	Discharge capacity of the 2nd cycle (mAh g^{-1})	Discharge capacity of the50th cycle (mAh g^{-1})	Decay rate (%) from 2 to 50 cycles
C@MoS_2@C	0.1 C	1000.0	871.9	0.26
Pure MoS_2 assembly		778.9	342.4	1.14
		Discharge capacity of the 15^{th} cycle (mA h g^{-1})	Discharge capacity of the 200^{th} cycle (mA h g^{-1})	Decay rate (%) from 15 to 200 cycles
C@MoS_2@C	1 C	600.0	570.9	0.026

Tab. S1 Discharge cparacities of C@MoS_2@C and of pure MoS_2 assembly at different current densities and after different cycle numbers.

	Pure MoS_2 assembly	C@MoS_2@C hollow spheres
R_E/Ω	8.3±0.4	6.8±0.5
R_{CT}/Ω	344.2±0.6	114.5±1.5
$CPE_{DL}/\mu F$	2.1±0.05	3.1±0.2
α	0.75±0.5	0.76±0.5

Tab. S2 Simulated data of the EIS by using the equivalent circle shown in Fig. 7. The data are based on the average value with standard deviation from three measurements for each sample.

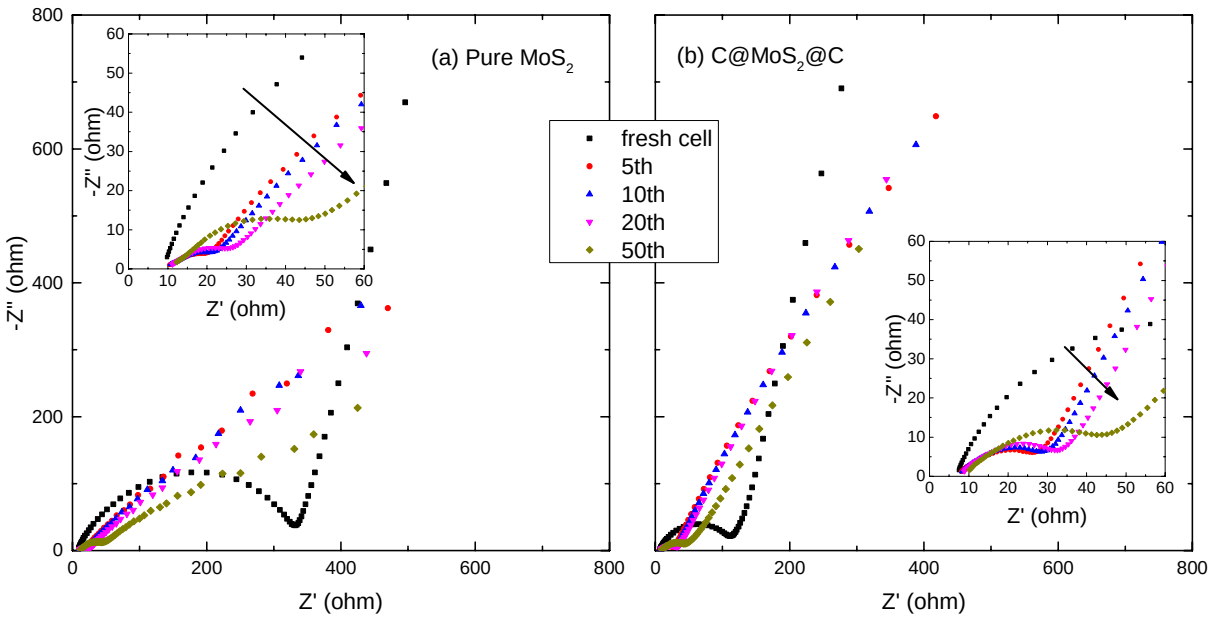

Fig. S11 Impedance measurements on pure MoS_2 assembly (a) and C@MoS_2@C hollow spheres (b) before and after a specific number of cycles.

MoS_2 hollow structures	Initial discharge capacity (mA h g^{-1})	Discharge capacity (mA h g^{-1}) after several cycles	Potential range (V)	Current density (mA g^{-1})	Ref.
C@MoS_2@C hollow spheres	1373	876 (after 100 cycles)	0.01-3.0	67	Present work
Yolk-shell MoS_2	790	687 (after 100 cycles)	0.01-3.0	1000	[1]
MoS_2/C quasi hollow spheres	566	652 (after 100 cycles)	0.01-3.0	100	[2]
MoS_2/C nanospheres @ hollow microsphere hierarchical structure	1050	878 (after 100 cycles)	0.01-3.0	100	[3]
MoS_2 hollow microbox	1000	900 (after 50 cycles)	0.05-3.0	100	[4]
Hierarchical Hollow MoS_2 Nanoparticles	1236	902 (after 80 cycles)	0.01-3.0	100	[5]

Tab. S3 Discharge capacities of various MoS_2 hollow structures.

References

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