Electronic Supplementary Information

Glucose-assisted synthesis of the hierarchical TiO_2 nanowires @ MoS_2 nanosheets nanocomposite and its synergistic lithium storage performance

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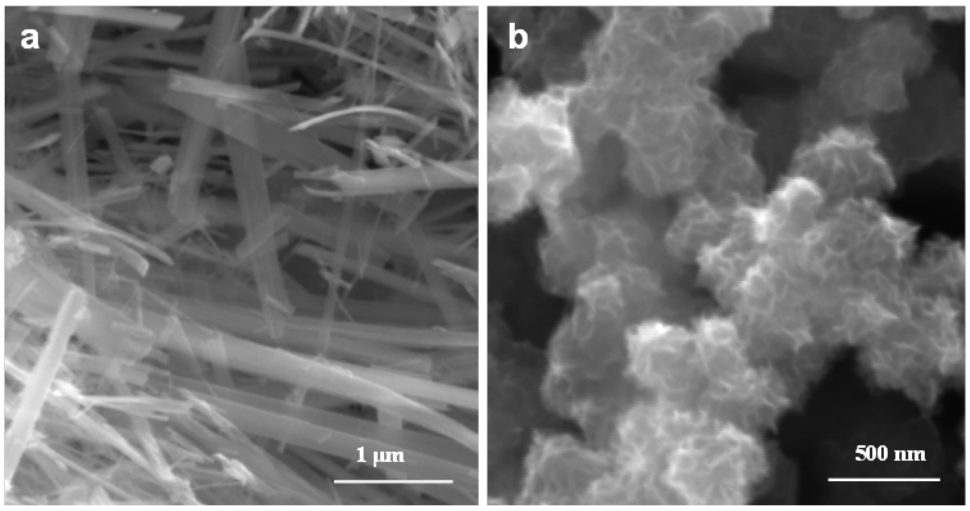
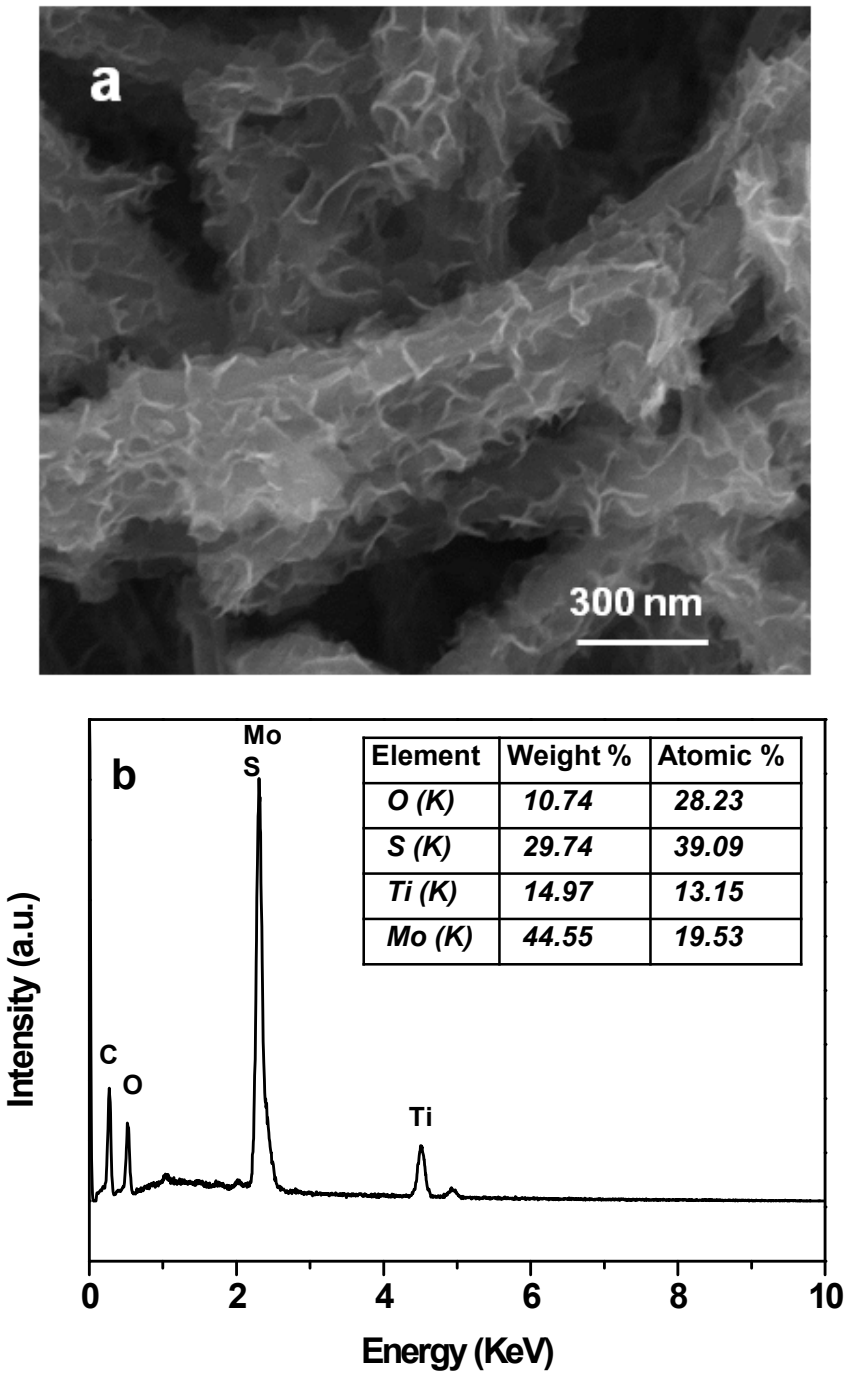


Figure S1 SEM images of (a) bare TiO_2 nanowires and (b) bare MoS_2 particles assembled by nanosheets.



Element	Weight %	Atomic %
O (K)	*10.74*	*28.23*
S (K)	*29.74*	*39.09*
Ti (K)	*14.97*	*13.15*
Mo (K)	*44.55*	*19.53*

Figure S2 SEM image (a) and EDX spectrum (b) of the annealed TiO_2@MoS_2 nanocomposite.

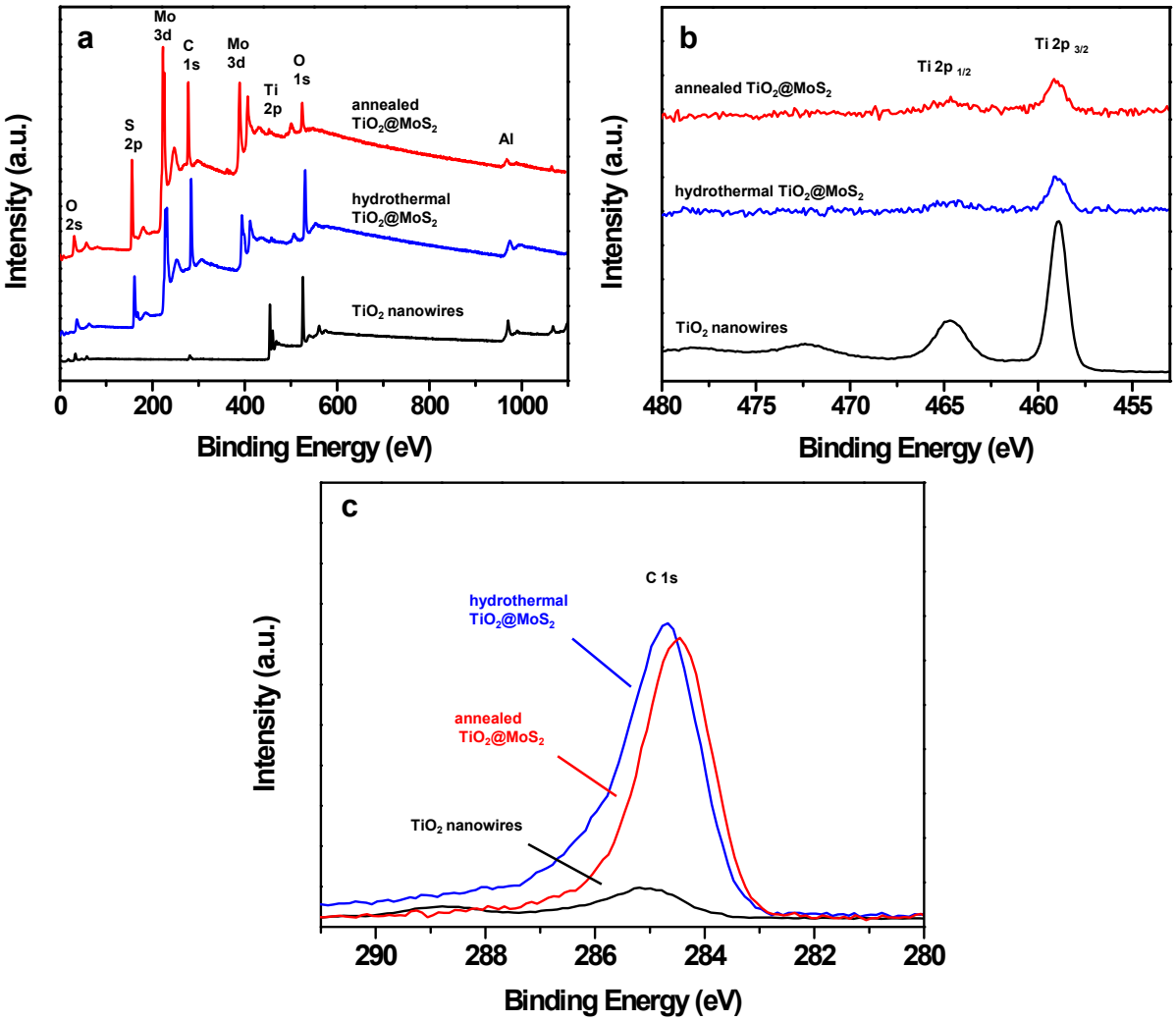


Figure S3 XPS spectra of the TiO_2 nanowires, the hydrothermal and annealed TiO_2@MoS_2 nanocomposites: (a) the full spectrum scans, (b) Ti 2p peaks and (c) C 1s peaks.

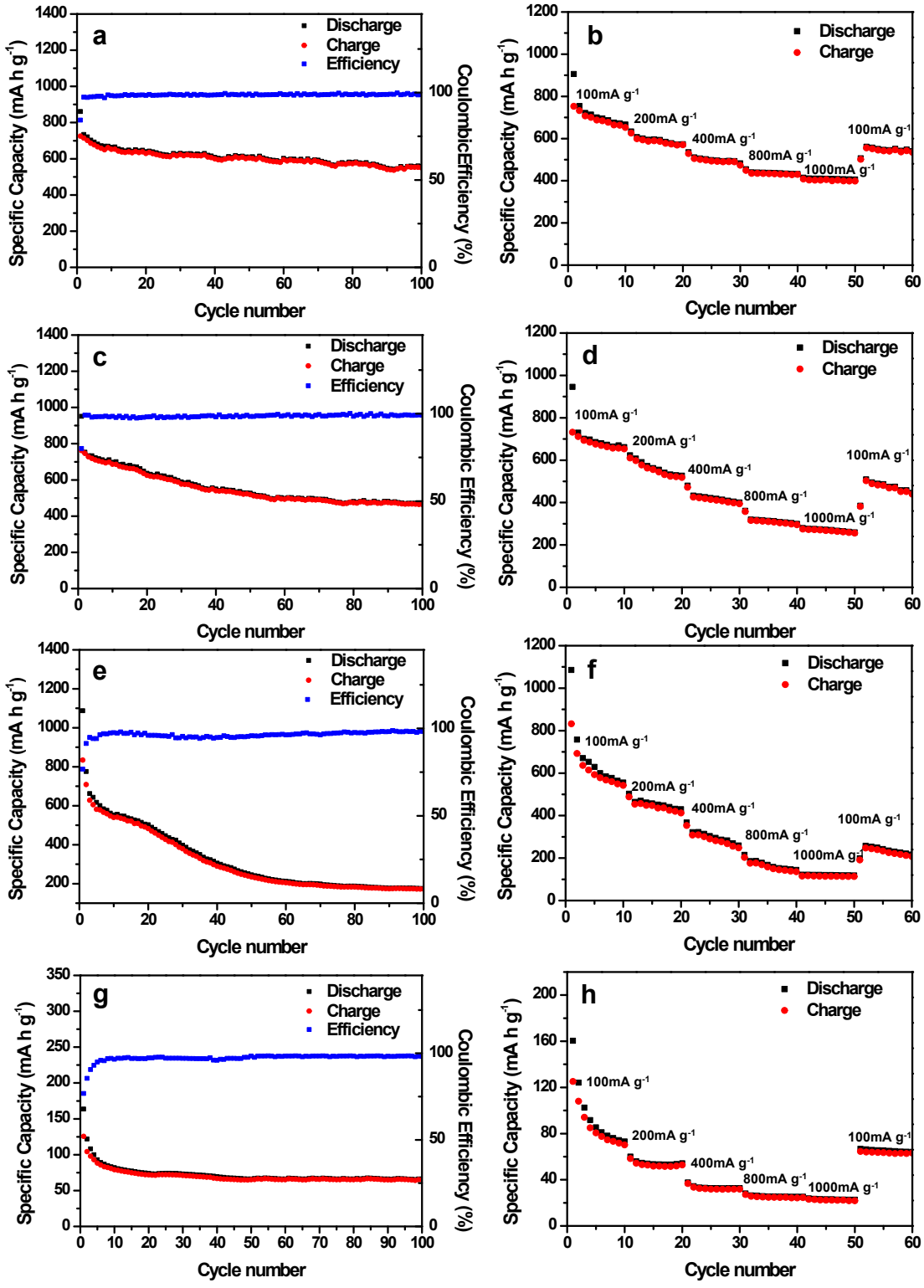


Figure S4 Cycle performances and Coulombic efficiencies of (a) the annealed TiO_2@MoS_2 nanocomposite, (c) the hydrothermal TiO_2@MoS_2 nanocomposite, (e) pure MoS_2 nanosheets and (g) bare TiO_2 nanowires; rate performances of (b) the annealed TiO_2@MoS_2 nanocomposite, (d) the hydrothermal TiO_2@MoS_2 nanocomposite $_2$, (f) pure MoS_2 nanosheets and (h) bare TiO_2 nanowires.

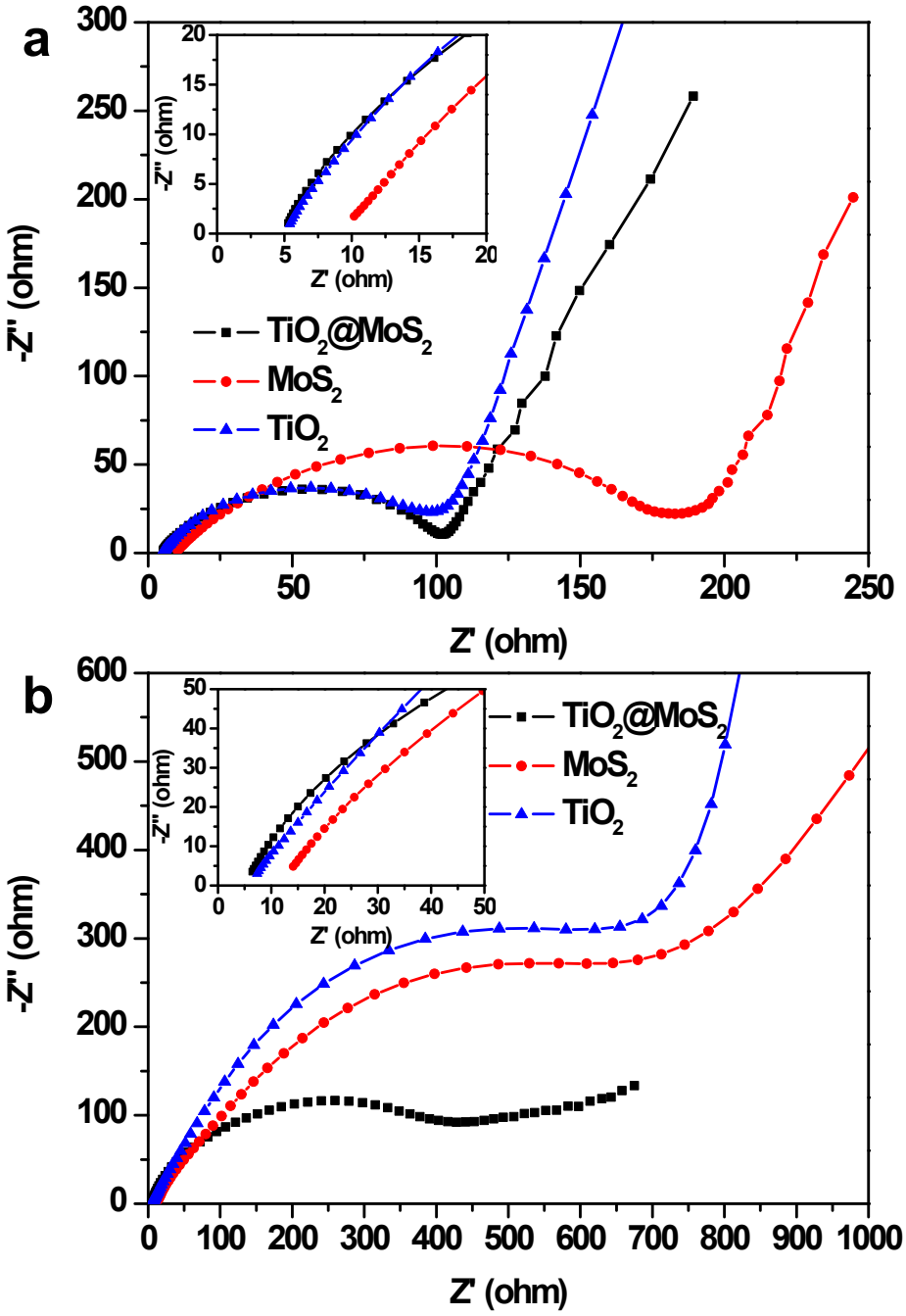


Figure S5 Electrochemical impedance spectra (100 kHz – 100 mHz) of TiO_2@MoS_2 nanocomposites, bare TiO_2 nanowires and MoS_2 nanosheets: (a) before cycling and (b) after 100 cycles at the delithiation state. Two insets are the corresponding magnified high frequency region of (a) and (b), respectively.

Electrochemical impedance spectra (EIS) are shown in Figure S5 in the form of Nyquist plots. Before cycling, TiO_2@MoS_2 shows a smaller semicircle diameter than bare TiO_2 and MoS_2, indicating the nanocomposite has lower charge transfer resistance (R_{ct}). After 100 cycles, the semicircle diameter for each sample significantly increases, due to the formation of SEI layers. However, TiO_2@MoS_2 still displays lower R_{ct} compared to either TiO_2 or MoS_2, demonstrating the enhanced kinetic performance,

cycling stability and improved conductivity and Coulombic efficiency of the nanocomposite. Furthermore, the plot (See inset of Figure S6a) of bare MoS_2 is shifted along the real axis by ~10 Ohm initially, which is substantially larger than that of TiO_2@MoS_2 and bare TiO_2. This value is the sum of all electrical resistances within the electrodes, including ionic diffusion through the electrolyte to electrode.[1, 2] Therefore TiO_2@MoS_2 shows enhanced total electrical conductivity in contrast with either single component initially. Even after 100 cycles, the plot of TiO_2@MoS_2 (Inset of Figure S6b) shows the smallest shift along the real axis, further highlighting the synergistic effects in the nanocomposite. The ESI results demonstrate that the hybrid nanocomposite structure can effectively mitigate the SEI formation and thus improve the conductivity and Coulombic efficiency, highlighting the synergistic effect.

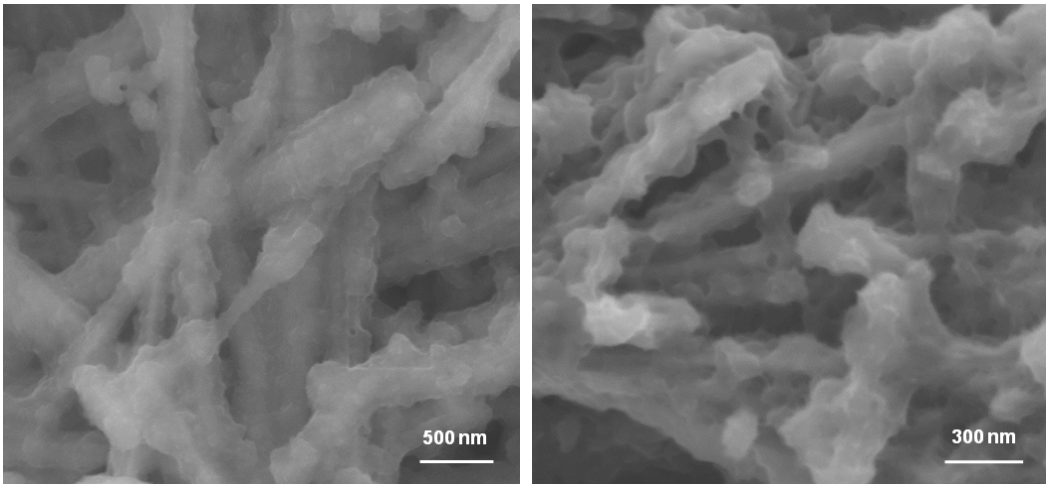


Figure S6 SEM images of the annealed TiO_2@MoS_2 nanocomposite after 100 cycles.

SEM images (Figure S6) of TiO_2@MoS_2 after 100 cycles of charge-discharge demonstrate that TiO_2@MoS_2 nanocomposite almost retains its original 1D hierarchical nanostructure. This retentivity benefits the improved electrochemical properties.

References

1. E. Memarzadeh Lotfabad, P. Kalisvaart, K. Cui, A. Kohandehghan, M. Kupsta, B. Olsen and D. Mitlin, *Phys. Chem. Chem. Phys.*, 2013, **15**, 13646.

2. E. L. Memarzadeh, W. P. Kalisvaart, A. Kohandehghan, B. Zahiri, C. M. B. Holt and D. Mitlin, *J. Mater. Chem.*, 2012, **22**, 6655