Electronic Supplementary Material

TiN@C nanocages as multifunctional sulfur hosts for superior lithium-sulfur batteries

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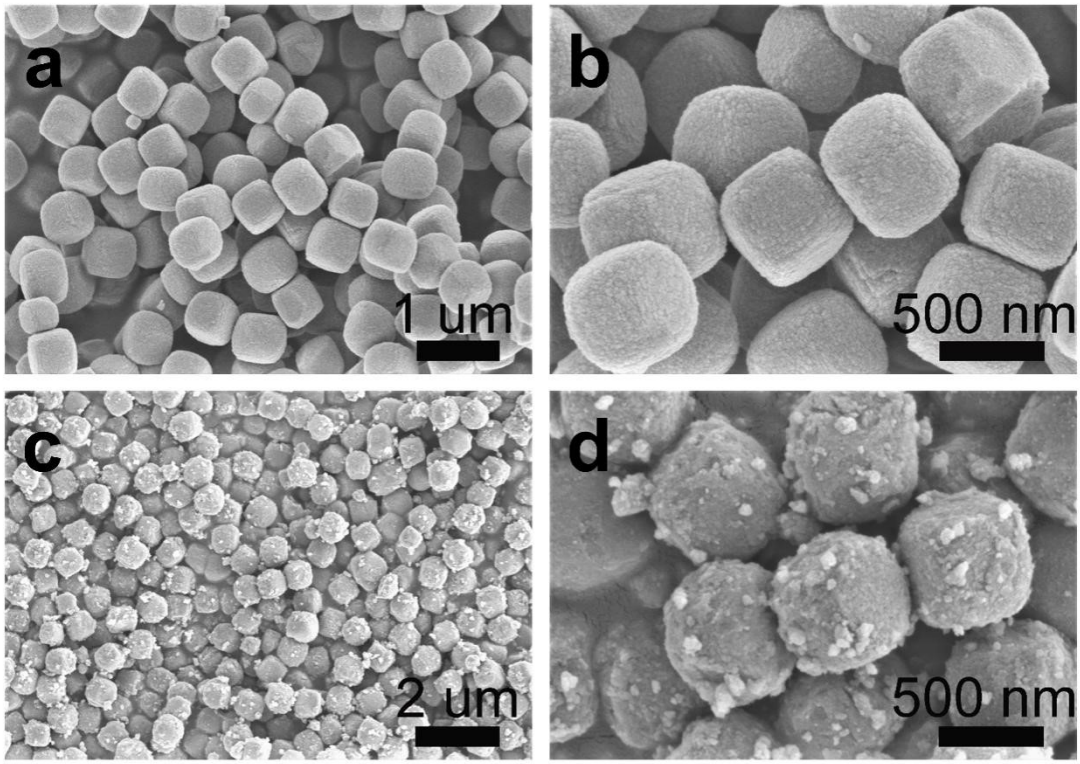

Fig. S1. SEM images of (a-b) Fe_2O_3 nanocube, (c-d) Fe_2O_3@TiO_2 nanocube.

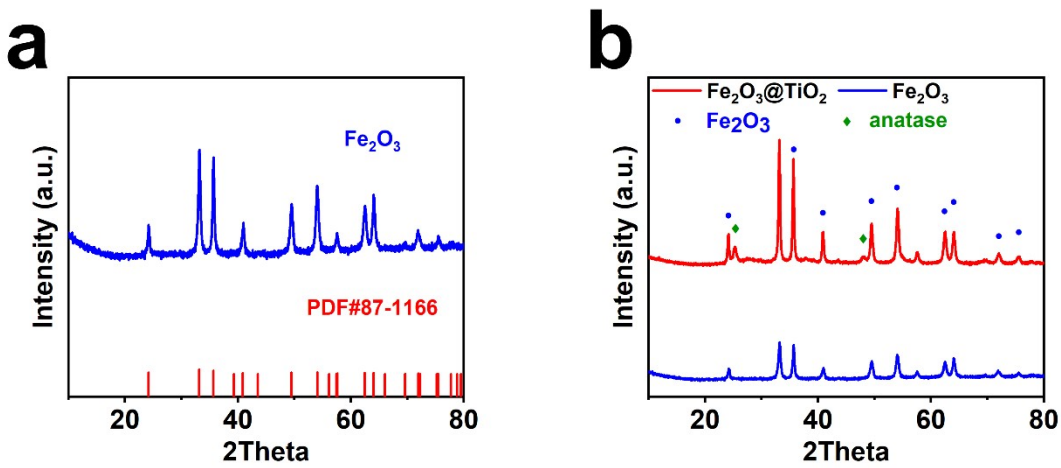

Fig. S2. XRD patterns of (a) Fe_2O_3 nanocube, (c-d) Fe_2O_3@TiO_2 nanocube.

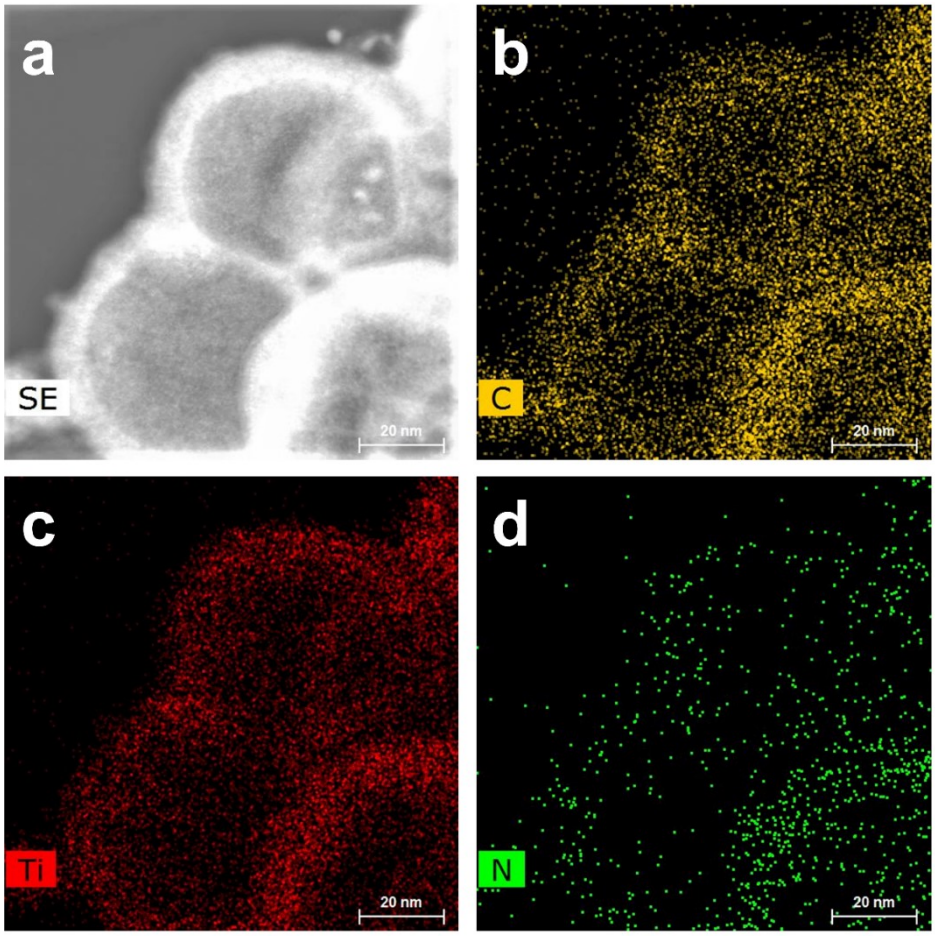

Fig. S3. (a-d) Element mapping of TiN@C nanocages.

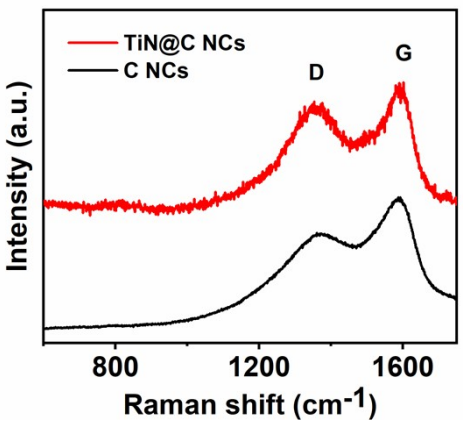

Fig. S4. Raman spectra of TiN@C and C nanocage.

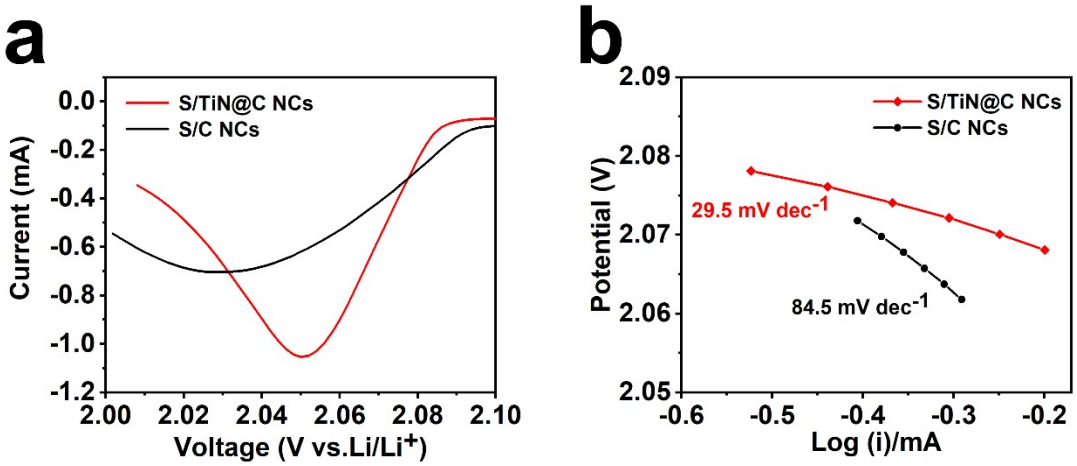

Fig. S5. (a) Details obtained from CV curves, (b) Tafel plots calculated from the CV reduction peak at 2.05 V.

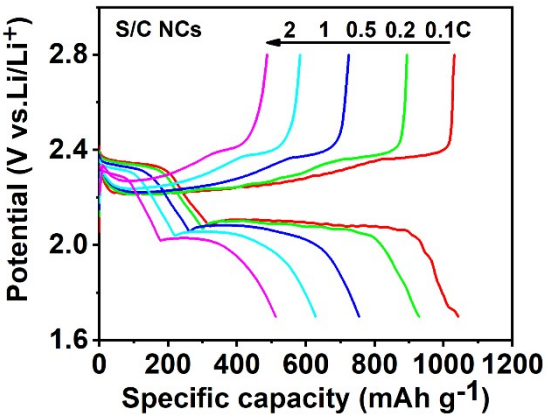

Fig. S6. Charge−discharge curves of S/C NCs cathode at different rates.

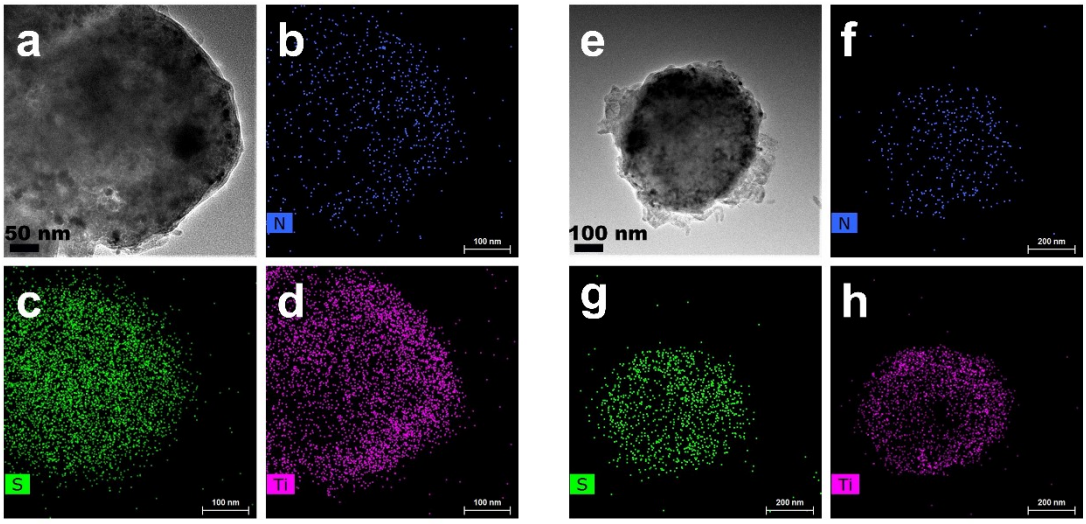

Fig. S7. (a-d) The existence of the polysulfides in the electrodes in the middle of charge, (e-h) The existence of the polysulfides in the electrodes in the middle of discharge.

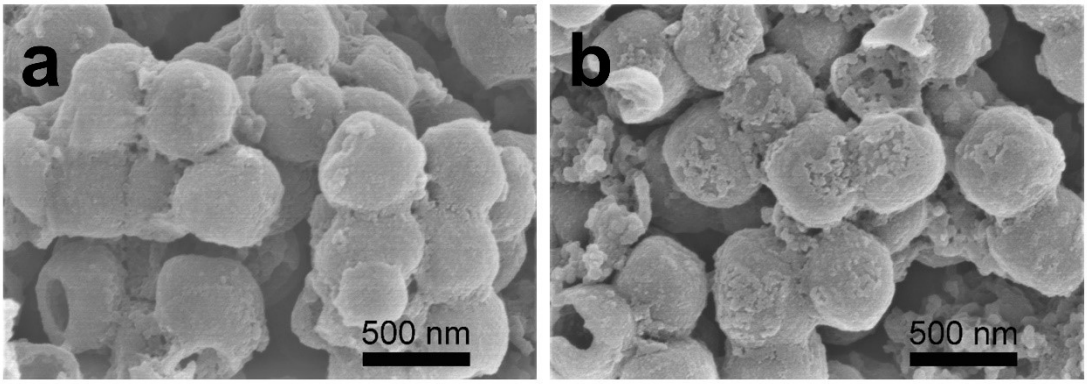

Fig. S8. (a-b) SEM image of S/TiN@C NCs after 200 cycles at 0.5 C.

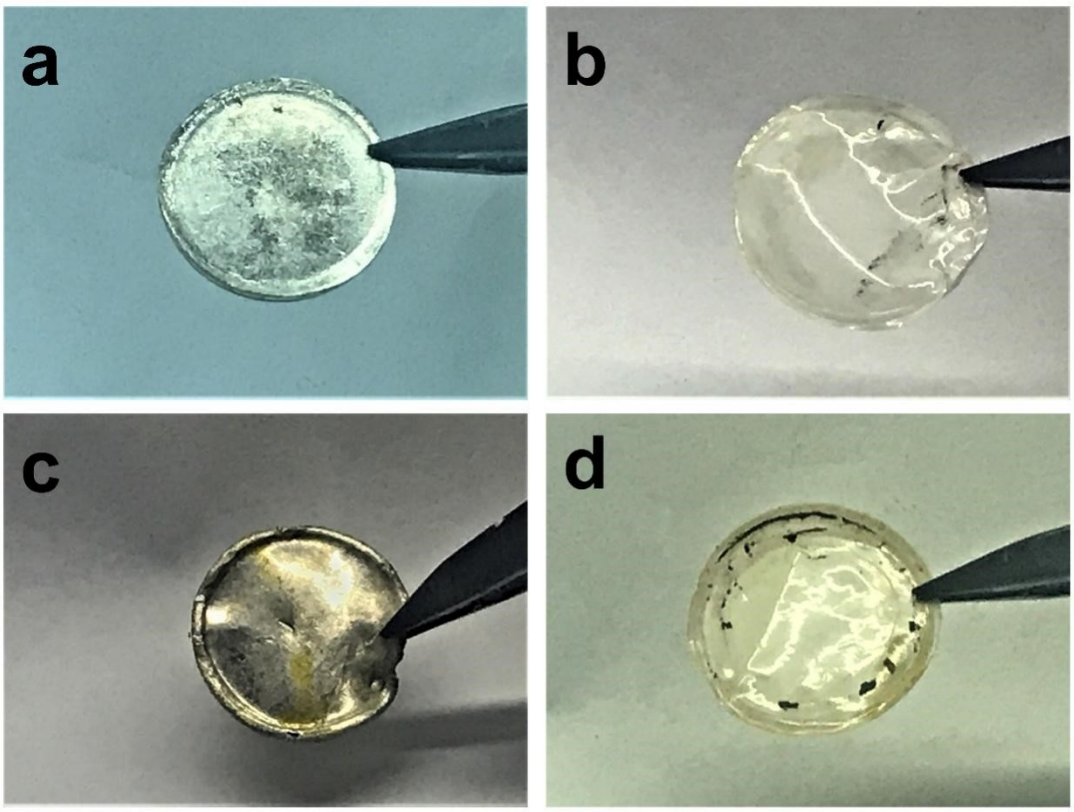

Fig. S9. (a-b) The optical photos of lithium plate and separator in the battery based on S/TiN@C electrode after 200 cycles at 0.5 C, (c-d) The optical photos of lithium plate and separator in the battery based on S/C electrode after 200 cycles at 0.5 C.

Table S1 Performance comparisons with similar materials

Materials	Rate capacity	References
TiN@C	1415 mAh g-1 (0.1 C) 781 mAh g-1 (2 C)	This work
TiN@rGO	1205 mAh g-1 (0.1 C) 695 mAh g-1 (2 C)	[1]
TiN-S	1150 mAh g-1 (0.1 C) 645 mAh g-1 (2 C)	[2]
TiN@NG	1390 mAh g-1 (0.1 C) 850 mAh g-1 (1.5 C)	[3]
TiN	1138 mAh g-1 (0.1 C) 737 mAh g-1 (1 C)	[4]
		1C= 1675 mA g^{-1}

Notes and references

[1] R. Luo, Q. Yu, Y. Lu, M. Zhang, T. Peng, H. Yan, X. Liu, J. Kim, Y. Luo, *Nanoscale Horizons*., 2019, 4, 531-539.

[2] B. Hao, H. Li, W. Lv, Y. Zhang, S. Niu, Q. Qi, S. Xiao, J. Li, F. Kang, Q. Yang, *Nano Energy*., 60 (2019) 305–311

[3] W. Chen, H. Jin, S. Xie, H. Xie, J. Zhu, H. Ji, L. Wan, *Journal of Energy Chemistry.,* 54 (2021) 16-22

[4] Y. Lu, Y. Wang, W. Wang, Y. Guo, Y. Zhang, R. Luo, X. Liu, T. Peng, *Journal of Physics D: Applied Physics*., 2019, 52, 025502