

Electronic Supplementary Material (ESI) for
Nanoscale Advances. This journal is © The Royal
Society of Chemistry 2022

Supporting Information

Nano sulfur confined in 3D carbon nanotube/graphene network as a free-standing cathode for high-performance Li-S batteries

Meng Wei^{1, 2, *}, Huiqin Zhu¹, Pengfei Zhai¹, Longkun An¹, Hengyi Geng¹, Song Xu^{1, *}, Tao Zhang¹

¹School of Materials Science and Engineering, Zhengzhou University of Aeronautics, Zhengzhou 450046;

Henan Key laboratory of Aeronautical materials and Application Technology, Zhengzhou 450015, China

²Collaborative Innovation Center of Aviation Economy Development, Henan Province

* Corresponding author: weimeng1005@zua.edu.cn; songxu@zua.edu.cn

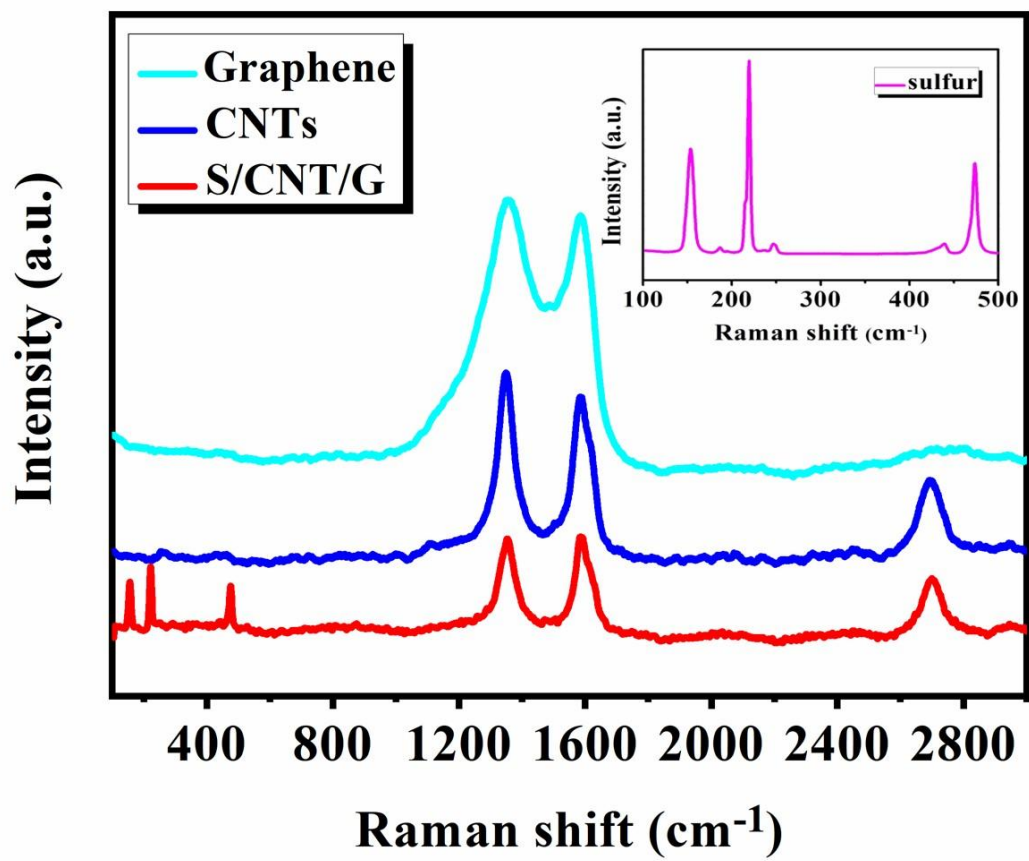


Fig.S1 Raman spectra of the graphene, CNT and S/CNT/G composite.

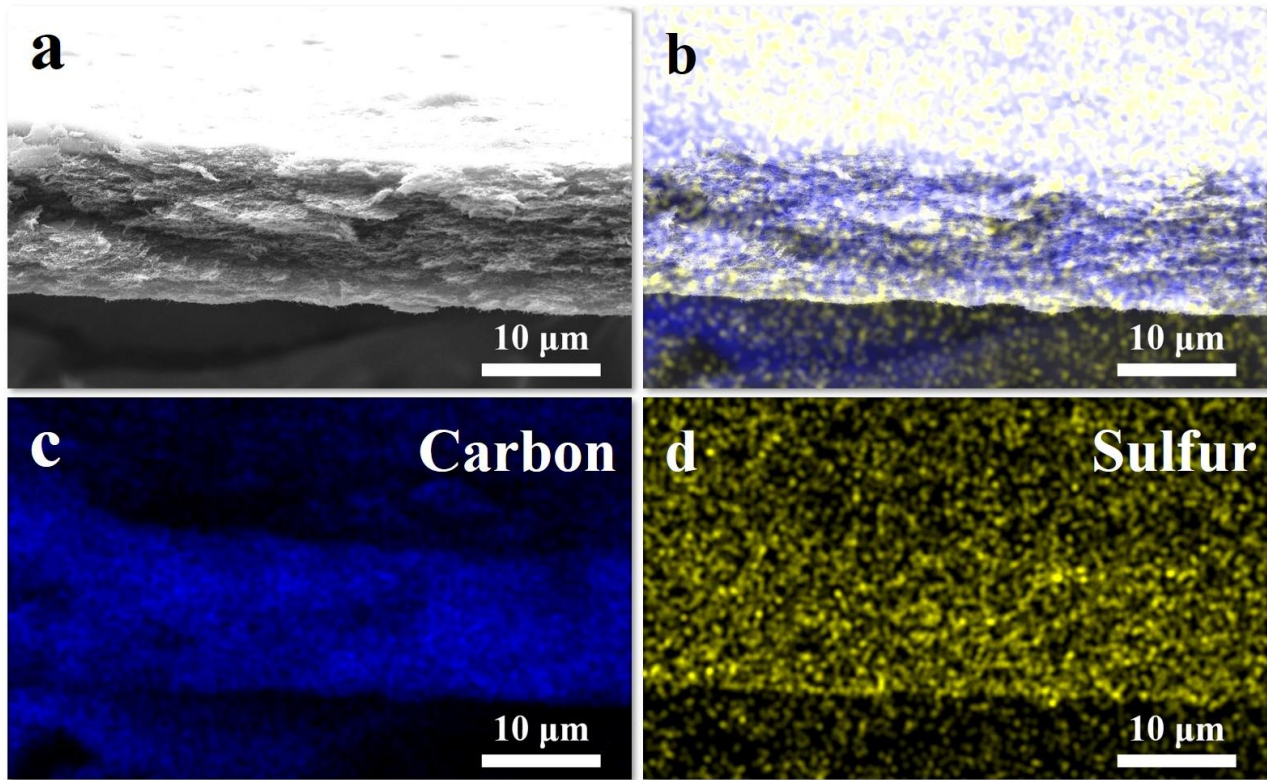


Fig.S2 The cross-sectional images and EDX elemental analysis of the free-standing S/CNT/G electrode.

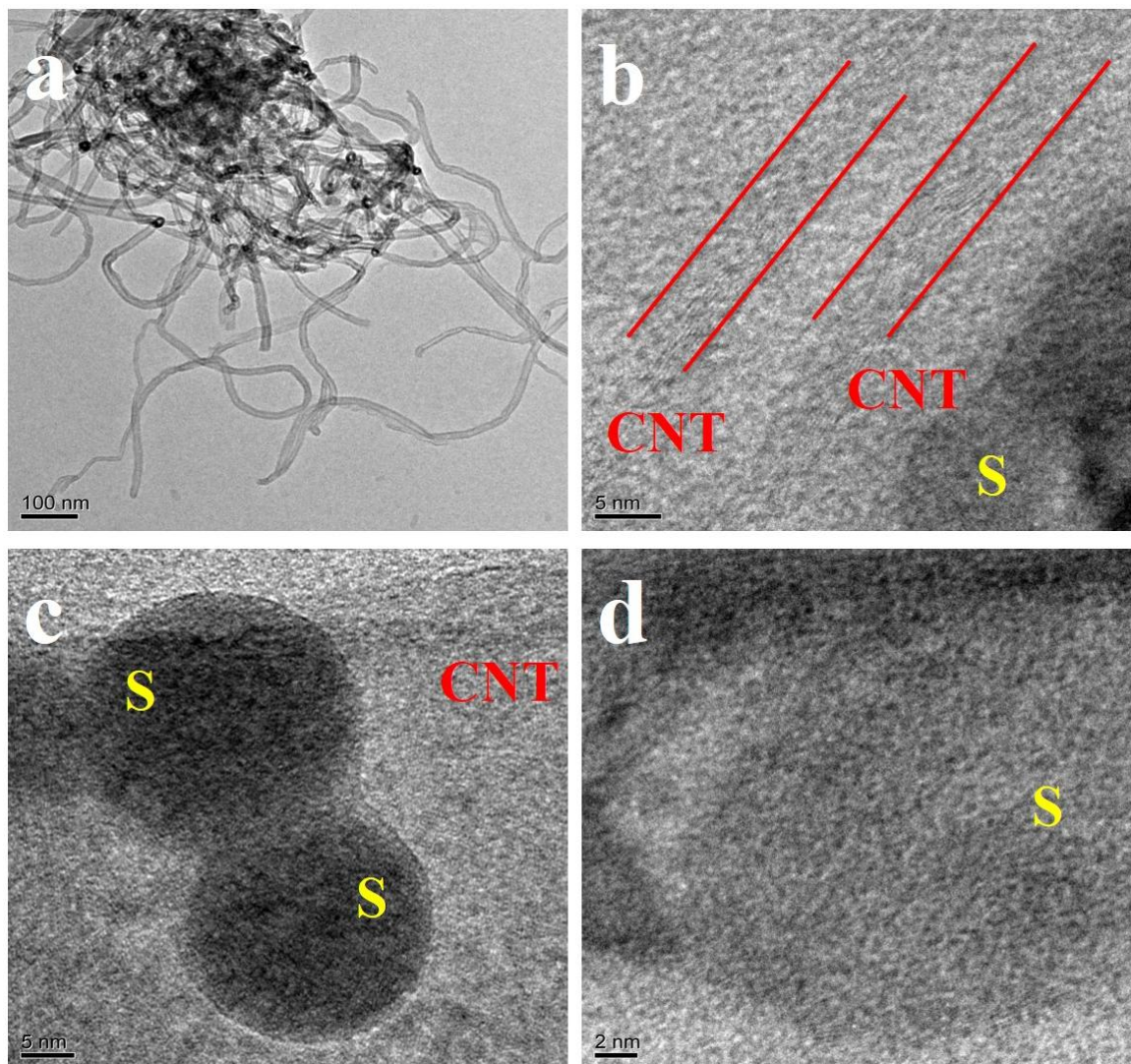


Fig.S3 HTEM images at different magnifications, CNT (a), S/CNT/G (b), nano sulfur (c)-(d).

State	$R_s(\Omega)$	$R_{ct}(\Omega)$	$R_f(\Omega)$
Fresh cell	5.0 Ω	34.7 Ω	98.9 Ω
After 200 cycles	7.2 Ω	9.9 Ω	

R_s : internal resistance;

R_{ct} : charge transfer resistance;

R_f : interfacial resistance between electrolyte/electrode.

Table S2. Sulfur loading and electrochemical properties of flexible sulfur-based cathode in this work and literature.

Material	Rate /Current density	Capacity after cycling (Cycle number)	Sulfur loading	Reference
S/CNT/G	0.5 C	593 (200)	1.5-2 mg cm ⁻²	This work
GO/CNT	0.2 C	1003.59 (50)	1.1 mg cm ⁻²	S1
G/SWCNT-S	5 C	650 (100)		S2
S@MWCNT-PANI-G	0.2 C	784 (100)	0.8-1 mg cm ⁻²	S3
graphene/S	0.2 A g ⁻¹	840 (100)	0.86 mg cm ⁻²	S4
NiO-CNT/S	0.1 C	609 (160)	2.1 mg cm ⁻²	S5
ZnS-CNTs/S@NH	0.5 C	760 (150)	1.8-2.3 mg cm ⁻²	S6
S@HZIF/CNT	0.5 C	624.6 (500)	2.13 mg cm ⁻²	S7
FeOOH/CNT@S	1 A g ⁻¹	742 (200)	1.71 mg cm ⁻²	S8
FMC@S	0.5 C	666 (350)	1 mg cm ⁻²	S9
rGO/g-C3N4/CNT/S	0.2 C	820 (200)	4.2 mg cm ⁻²	S10

References:

- S1 . K. Lee, S. J. Kim, Y. J. Kim, H. Choi, D. W. Kim, H. J. Jeon, C. W. Ahn, J. W. Lee and H. T. Jung, *Adv. Mater. Interfaces*, 2019, **6**, 1801992.
- S2 . Q. Zhao, X. F. Liu, Q. Zhang, G. L. Tian, J. Q. Huang, W. C. Zhu, F. Wei. *Acs Nano*, **6**, 10759-10769.
- S3 . Deng, L. Yao, Q.-A. Huang, Q. Su, J. Zhang, F. Zhang and G. Du, *RSC Adv*, 2017, **7**, 9819-9825.
- S4 . Feng, H. Zhang, Y. Zhang and X. Qu, *ACS Omega*, 2019, **4**, 16352-16359.
- S5 . Jia, B. Liu, J. Liu, S. Zhang, Z. Sun, X. He, H. Li, G. Wang and H. Chang, *RSC Adv*, 2021, **11**, 10753-10759.
- S6 . Shi, C. Zhao, Y. Zhou, H. Yin, C. Song, L. Qin, Z. Wang, H. Shao and K. Yu, *J. Colloid Interface Sci.*, 2021, **599**, 416-426.
- S7 . Wu, L. Wang, S. Chen, X. Zhu, Q. Deng, J. Wang, Z. Zeng and S. Deng, *Chem. Eng. J.*, 2021, **404**, 126579.
- S8 . Li, Y. Xu and J. Wang, *ACS Appl. Energy Mater*, 2021, **4**, 8368-8376.
- S9 . Chen, X. Y. Yue, X. L. Li, J. Bao, Q. Q. Qiu, X. J. Wu, X. Zhang and Y. N. Zhou, *ACS Appl. Mater. Interfaces*, 2020, **12**, 2354-2361.
- S10 Wang, Z. Meng, W. Yang, X. Yan, R. Guo and W. Q. Han, *ACS Appl. Mater. Interfaces*, 2019, **11**, 819-827.

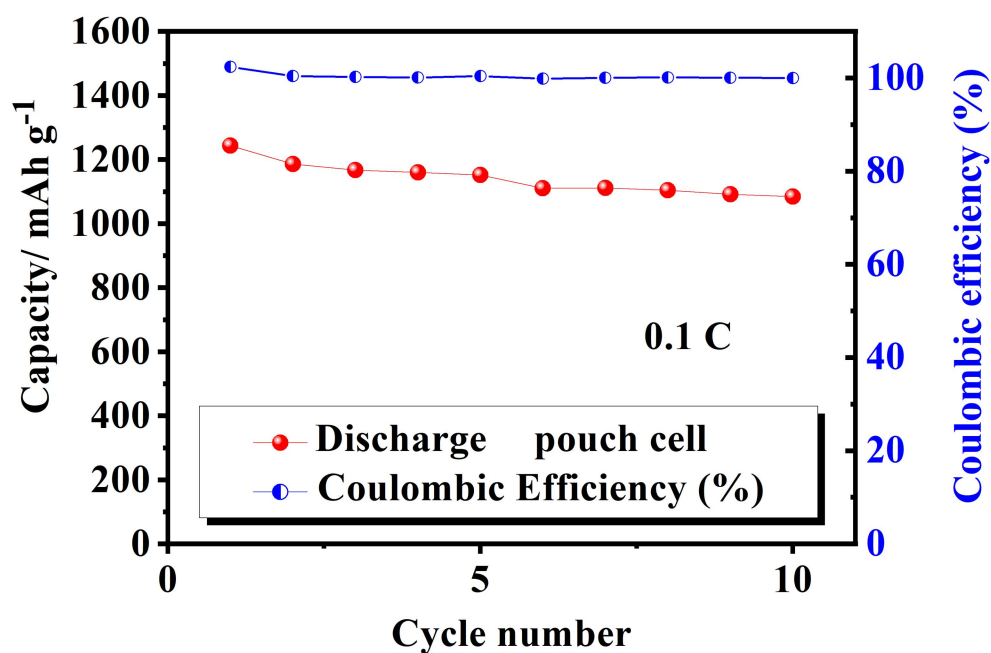


Fig. S4. Cycling performance of the pouch battery assembled by Li/copper foam anode and S/CNT/G film cathode at 0.1C.

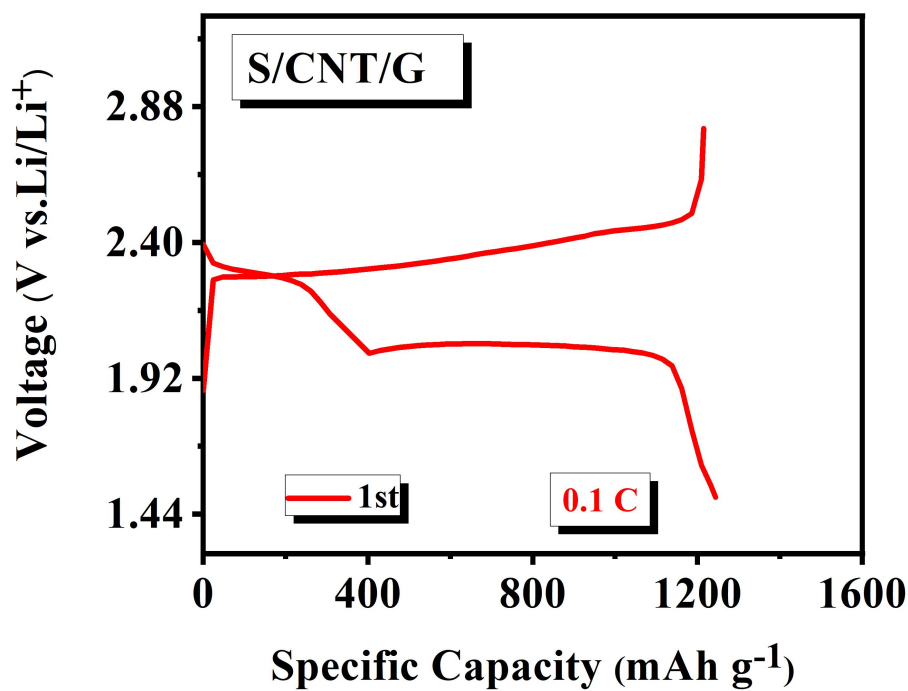


Fig. S5. Typical discharge-charge voltage curve of pouch battery at 0.1 C between 1.5 and 2.8 V.

