Electronic Supplementary Material (ESI) for Dalton Transactions.

A Waste Newspaper/Multi-Walled Carbon Nanotubes/TiO_2 Interlayer for Improving Cycling Stability of Lithium-Sulfur Battery by Anchoring Polysulfides

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Electronic Supplementary Information

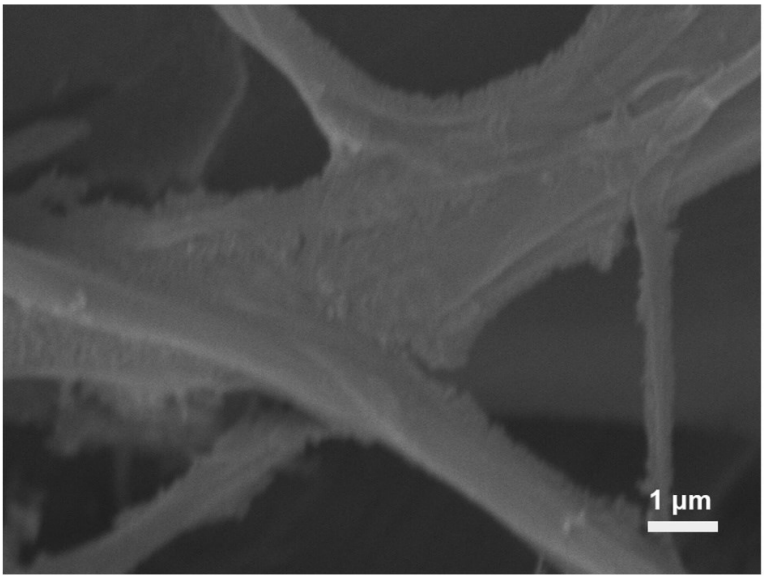

Figure S1. SEM image of newspaper after adsorbing ink.

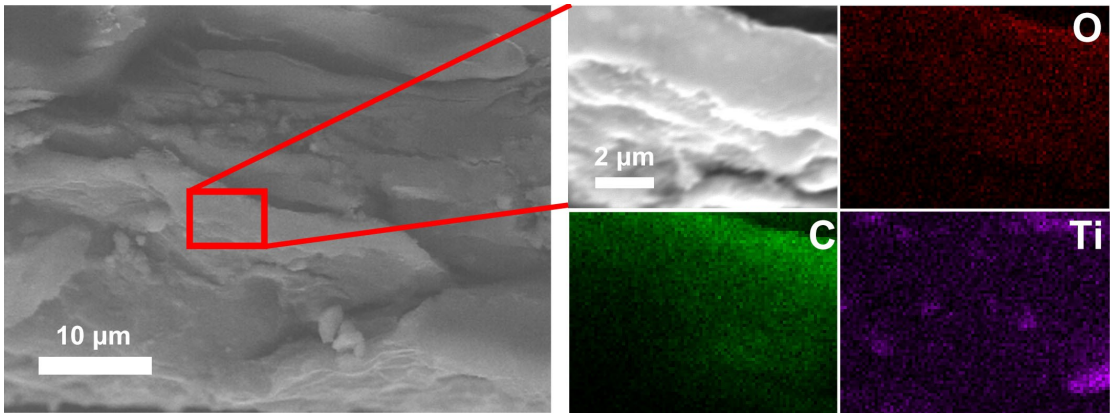

Figure S2. The lateral SEM of NMT interlayer and its corresponding elemental mappings of C, Ti, and O.

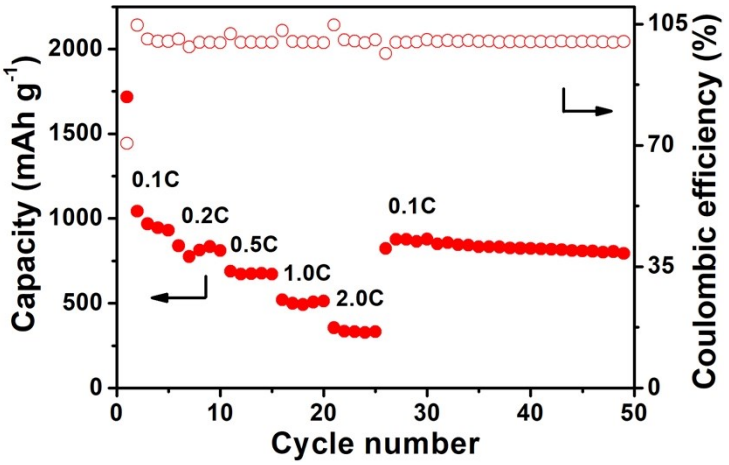

Figure S3. The rate performance of a Li-S battery with NMT-B interlayer at 0.1 C to 2.0 C.

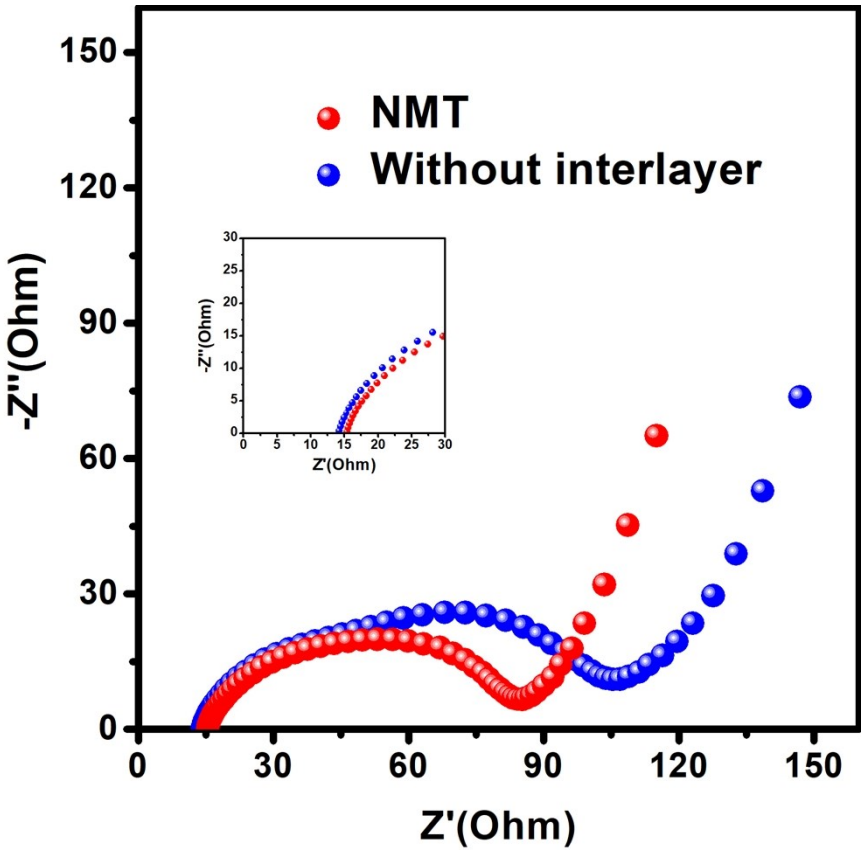

Figure S4. The EIS comparison of a Li-S battery with NMT interlayer and a Li-S battery without interlayer

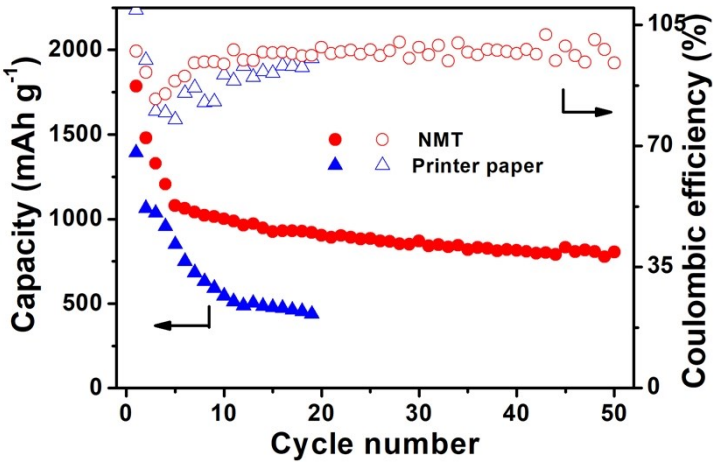

Figure S5. The cyclic performance of a Li-S battery with printer paper/MWCNT/TiO_2 and a Li-S battery with NMT interlayer at 0.1 C.

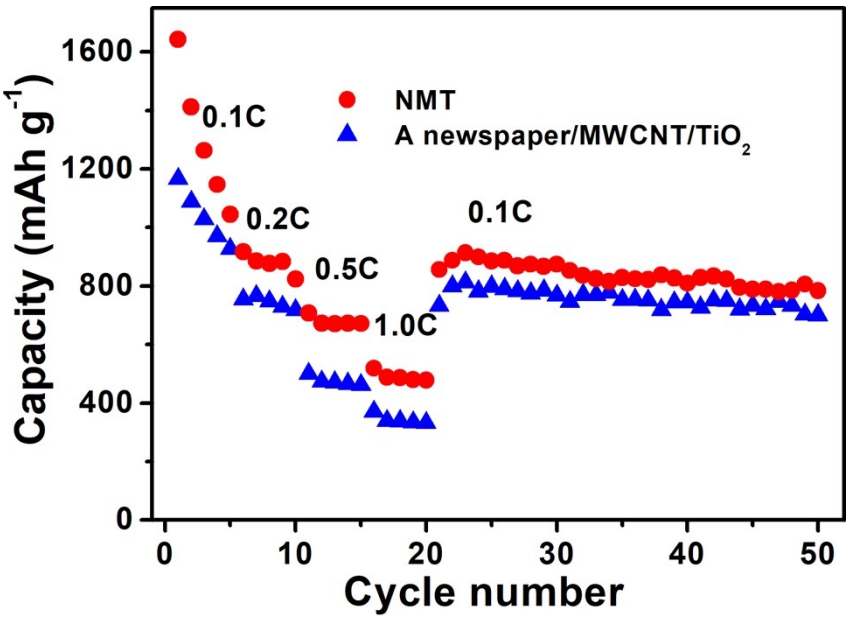

Figure S6. The cyclic performance of a Li-S battery with A newspaper/MWCNT/TiO_2 and a Li-S battery with NMT interlayer at 0.1 C.

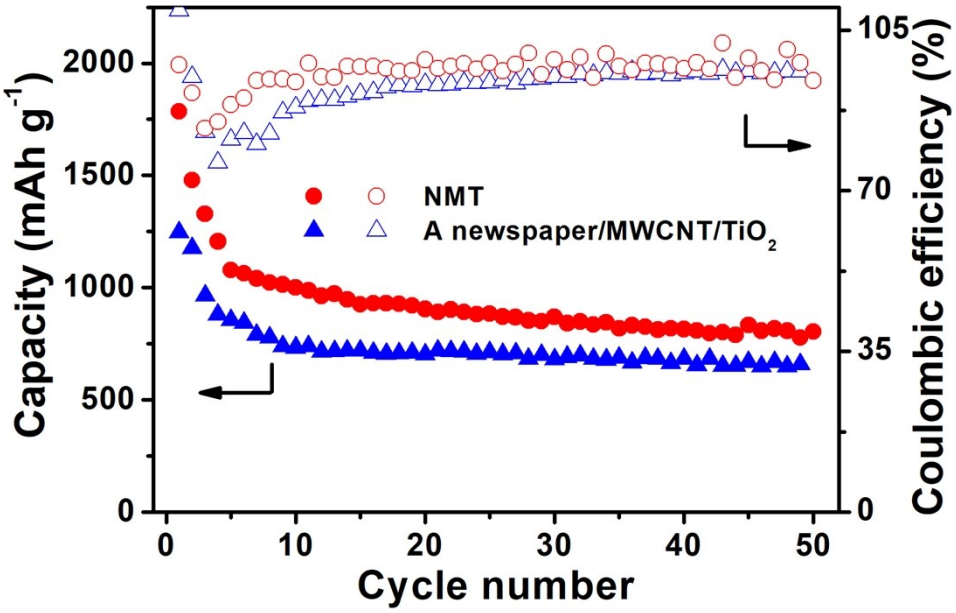

Figure S7. The rate performance of a Li-S battery with A newspaper/MWCNT/TiO_2 and a Li-S battery with NMT interlayer at 0.1 C to 2 C.

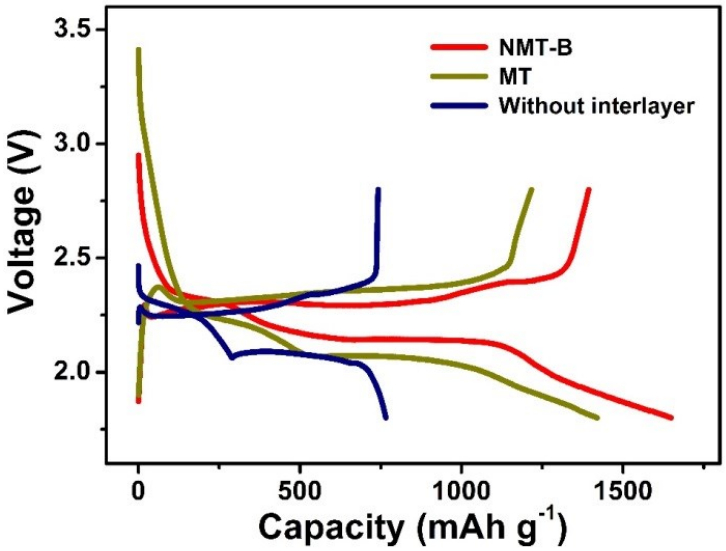

Figure S8. The initial charge/discharge profiles of Li-S batteries with NMT-B interlayer, MT interlayer, and without interlayer at 0.1 C.

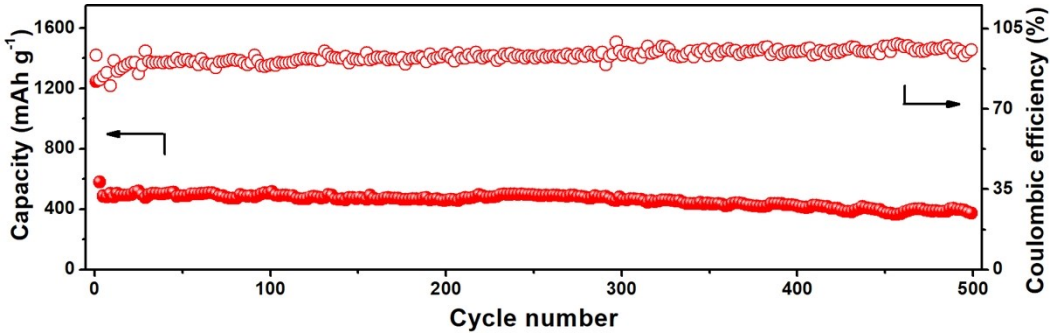

Figure S9. The cycle performance of a Li-S battery with NMT-B interlayer and sulfur load of 2.0 mg cm^{-2} in 0.5 C.

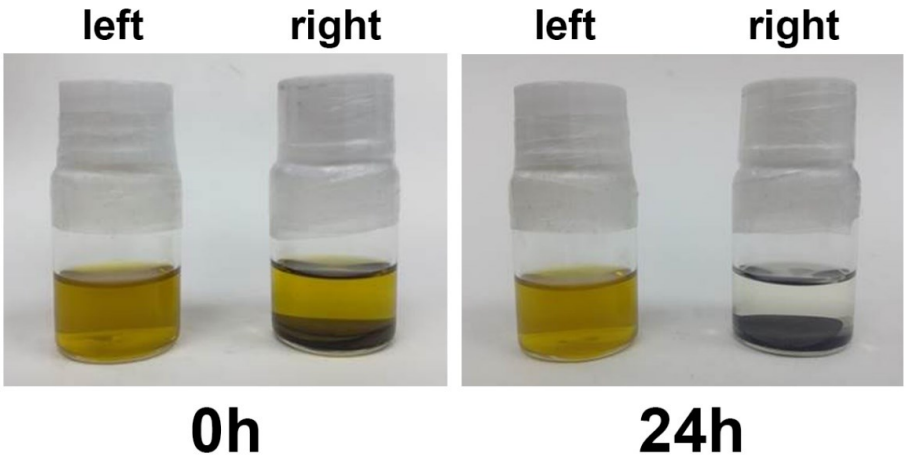

Figure S10. Optical photos of Li_2S_6 solution without (left) and with (right) NMT interlayer, after 24 h, the Li_2S_6 solution with the NMT interlayer becomes colorless.

Table S1. Comparison of the performance in Li-S batteries with reported kinds of cellulose-based interlayers.

Interlayer materials	Cycle number	Long-term decay rate	Sulfur loading (mg cm^{-2})	**Preparation Temperature (°C)**	Initial capacity (mAh g^{-1})
Carbonized Kimwipes[1]	200	0.14%	1.1	**800**	1308 (0.1 C)
CBC/TiO_2[2]	250	~0.146%	1.5	**1000**	1314 (0.2 C)
CCP[3]	130	0.105%	1.39	**800**	1200 (0.1 C)
CF/SPFEK/Super P[4]	500	0.047%	1.5-1.8	**900**	1178 (0.1 C)
Cellulose/GO[5]	200	0.250%	1	**60**	1325 (0.1 C)
Carbonized cotton fabric[6]	200	0.059%	5	**800**	1348.3 (0.1 C)
Carbonized filter paper[7]	50	0.920%	/	**800**	1500 (0.2 C)
Bamboo carbon fibers[8]	300	0.111%	2.1	**800**	907 (0.1 C)
CNF aerogel[9]	200	0.120%	2.74	**800**	1283 (0.2 C)
PBC/GO[10]	200	0.055%	2.4	**800**	1170 (0.1 C)
PBC/SnO_2[11]	120	0.4%	~3	**500**	812 (0.1 C)
This work	**500**	**0.071%**	**1.2**	**60**	**1391.4 (0.1 C)**

CBC: carbonized bacterial cellulose, CCP: Carbonized cellulose paper, CF: Carbon felt, CNF: carbon nanofiber, PBC: Pyrolyzed bacterial cellulose, GO: graphene oxide.

Electronic Supplementary Information References

1. S. Chung and A. Manthiram, *Chem. Commun.*, 2014, **50**, 4184.

2. F. Li, G. Wang, P. Wang, J. Yang, K. Zhang, Y. Liu and Y. Lai, *J. Electroanal. Chem.*, 2017, **788**, 150.

3. S. Li, G. Ren, M. Hoque, Z. Dong, J. Warzywoda and Z. Fan, *Appl. Surf. Sci.*, 2017, **396**, 637.

4. K. Yang, L. Zhong, R. Guan, M. Xiao, D. Han, S. Wang and Y. Meng, *Appl. Surf. Sci.*, 2018, **441**, 914.

5. Q. Zeng, X. Leng, K. Wu, I. Gentle and D. Wang, *Carbon*, **2015**, *93*, 611-619.

6. Q. Zhao, Q. Zhu, Y. An, R. Chen, N. Sun, F. Wu and B. *Appl. Surf. Sci.*, 2018, **440**, 770.

7. K. Zhang, Q. Li, L. Zhang, J. Fang, J. Li, F. Qin, Z. Zhang and Y. Lai, *Mater. Lett.*, 2014, **121**, 1981.

8. X. Gu, C. Li, F. Liu, W. Yang, Y. Hou and S. Zhang, *J. Mater. Chem. A*, 2015, **3**, 9502.

9. S. Li, J. Warzywoda, S. Wang, G. Ren and Z. Fan, *Carbon*, **2017**, *124*, 212.

10. Y. Shen, Z. Xiao, L. Miao, D. Kong, X. Zheng, Y. Chang, L. Zhi, *Rare Metals*, 2017, **36**, 418.

11. K. Celik, E. Cengiz, T. Sar, B. Dursun, O. Ozturk, M. Akbas and R. Demir-Cakan *J. Colloid interface Sci.*, 2018, **530**, 137.