ZnO nanoarrays modified nickel foam as a lithiophilic skeleton to regulate lithium deposition for lithium-metal batteries

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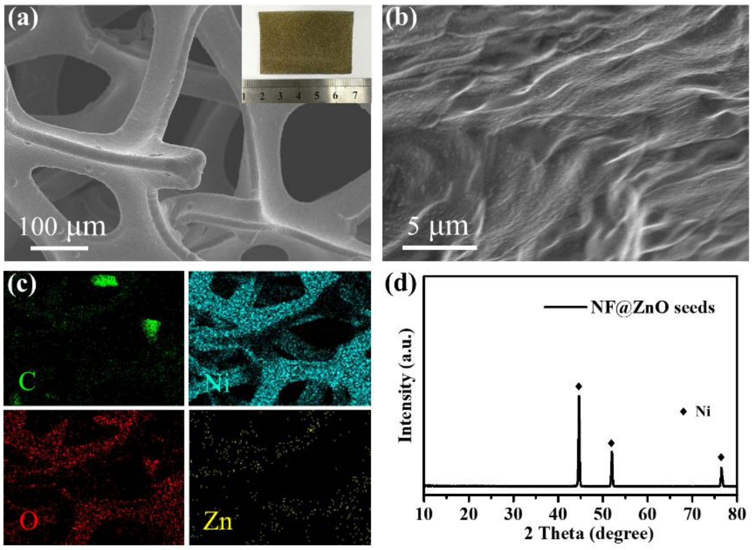

Fig. S1 (a) SEM image of the NF@ZnO seeds (the inset is its photograph), (b) high-magnification SEM image of NF@ZnO seeds, (c) elemental distribution mappings and (d) XRD patterns of the NF@ZnO seeds.

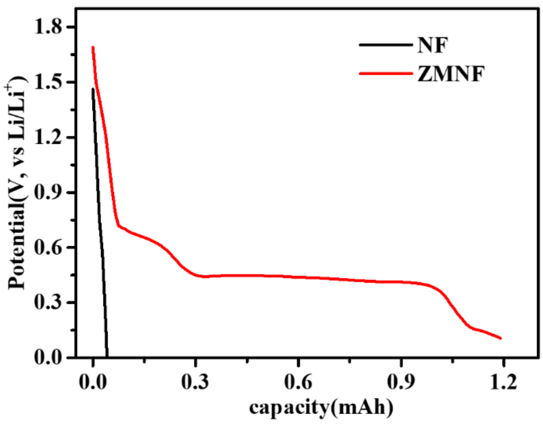

Fig. S2 Initial discharge profiles of Li-NF and Li-ZMNF half cells.

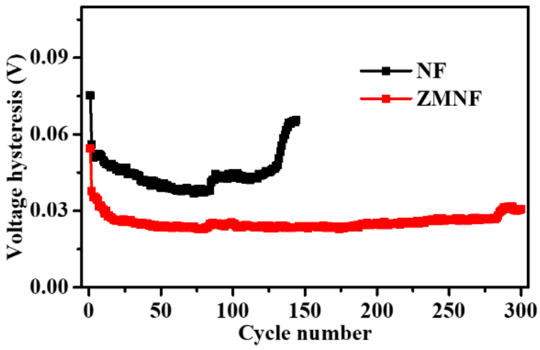

Fig. S3 Voltage hysteresis of Li plating/stripping median voltage at 1 mA cm^{-2} with a total capacity of 1.0 mA h cm^{-2}

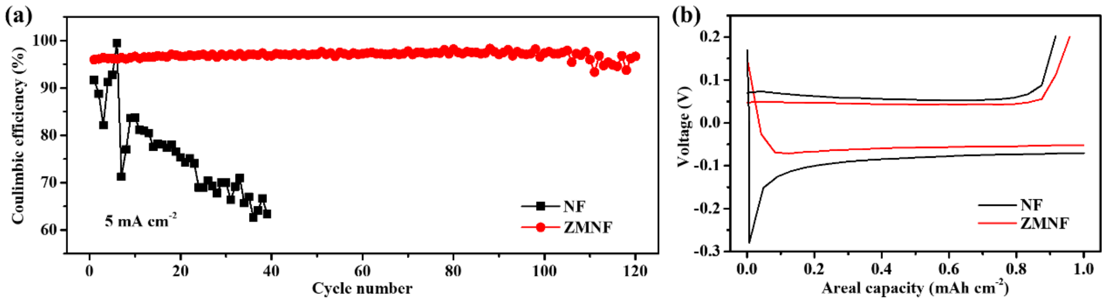

Fig. S4 (a) CE and (b) first discharge/charge profiles of Li-NF and Li-ZMNF half cells at 5.0 mA cm^{-2} for 1.0 mA h cm^{-2}.

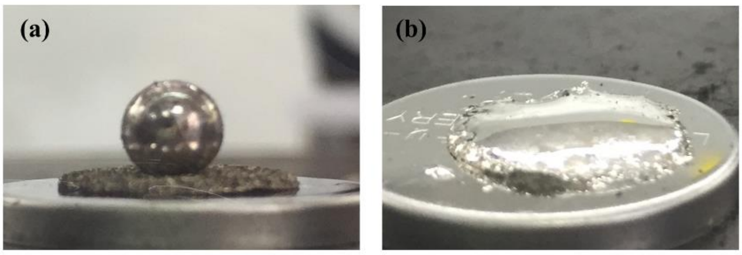

Fig. S5 Liquid Li wetting on (a) pristine Ni foam and (b) ZMNF at ~300℃.

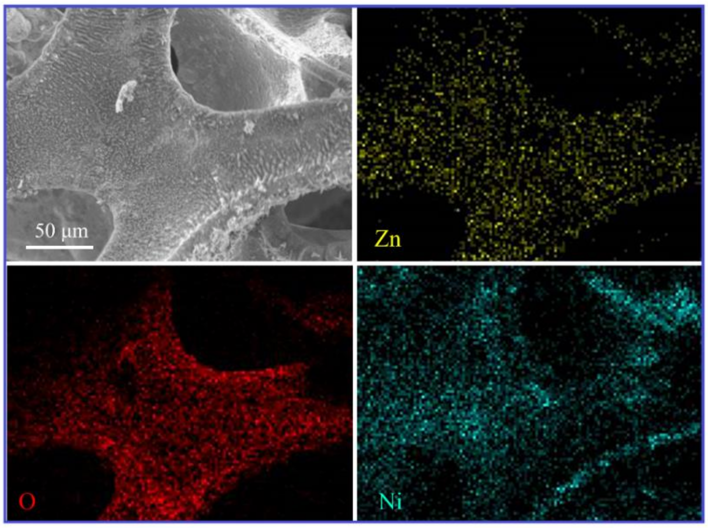

Fig. S6 SEM image and elemental distribution mappings in the region 2 near the red line.

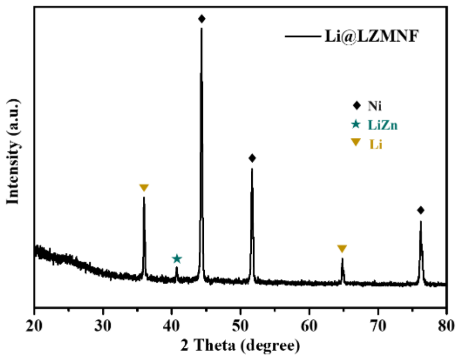

Fig. S7 XRD patterns of the region 1.

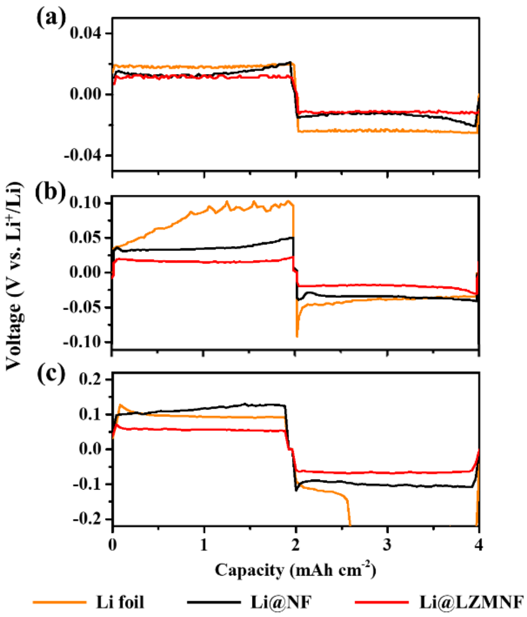

Fig. S8 The zoom-in images of voltage profiles of symmetric cells cycled at (a) 1 mA cm^{-2}, (b) 2 mA cm^{-2}, and (c) 5 mA cm^{-2} for 50th cycles.

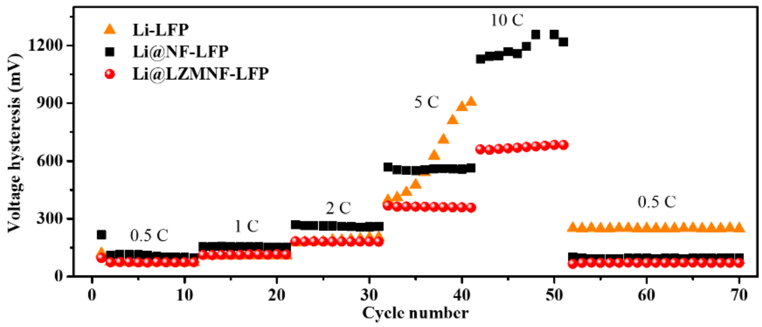

Fig. S9 Voltage hysteresis of charge/discharge median voltage at rates from 0.5 C to 10 C.

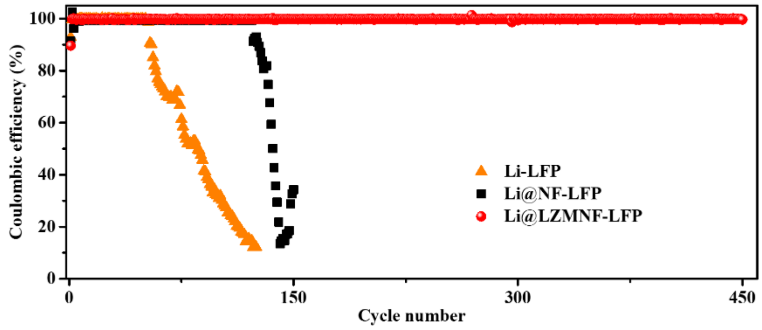

Fig. S10 CE of LFP-based full cells at 1 C.

Table S1. Comparison of Coulombic efficiency of Li plating/stripping on/from various current collectors with ether-based electrolyte.

Current collectors	Current density (mA cm^{-2})	Area capacity (mAh cm^{-2})	performance	Ref	year
Ni@CuNWs	2	1	96% for 100 cycles	1	2017
RGO@CuNWs	1	2	97% for 200 cycles	2	2018
N-doped GO@Ni foam	1	1	98% for 200 cycles	3	2018
CuO@Cu foil	0.5 1	1 0.5	94% for 180 cycles 94% for 180 cycles	4	2018
MnO_2@Ni foam	1	1	98.9% for 100 cycles	5	2018
ZMNF	**1** **3** **5**	**1** **1** **1**	**98.5% for 300 cycles** **97.9% for 200 cycles** **96.9% for 120 cycles**	**our work**	

Note: 1 M LiTFSI in DOL/DME with $LiNO_3$ (2 wt% $LiNO_3$ for Ni@CuNWs, 1 wt% $LiNO_3$ for the others)

Table S2. Comparison of galvanostatic cycling performance of symmetric Li cells with different composite Li anodes prepared by Li infusion method.

Current collectors	Electrolyte	Current density (mA cm^{-2})	Areal capacity (mAh cm^{-2})	performance
Ni@CuNWs[1]	1M $LiPF_6$ in EC/DEC	3	1	225 h
CuO@Cu foil[4]	1 M LiTFSI in DOL/DME, 1% $LiNO_3$	0.5	0.5	700 h
MnO_2@Ni foam[5]	1 M LiTFSI in DOL/DME, 1% $LiNO_3$	1	1	1600 h
		1	2	350 h
Carbonized ZIF-8[6]	1M $LiPF_6$ in EC/EMC/DMC, VC	1	1	700 h
		3	1	60 h
PI-ZnO matrix[7]	1 M LiTFSI in DOL/DME, 1% $LiNO_3$	1	1	~200 h
		3	1	~70 h
		5	1	~40 h
ZMNF	**1 M LiTFSI in DOL/DME, 1% $LiNO_3$**	**1**	**2**	**1200 h**
		2	**2**	**800 h**
		5	**2**	**300 h**

References

1. L.-L. Lu, Y. Zhang, Z. Pan, H.-B. Yao, F. Zhou and S.-H. Yu, *Energy Storage Materials*, 2017, **9**, 31-38.
2. K. Yan, B. Sun, P. Munroe and G. Wang, *Energy Storage Materials*, 2018, **11**, 127-133.
3. R. Song, B. Wang, Y. Xie, T. Ruan, F. Wang, Y. Yuan, D. Wang and S. Dou, *Journal of Materials Chemistry A*, 2018, **6**, 17967-17976.
4. C. Zhang, W. Lv, G. Zhou, Z. Huang, Y. Zhang, R. Lyu, H. Wu, Q. Yun, F. Kang and Q. H. Yang, *Advanced Energy Materials*, 2018, **8**, 1703404.
5. B. Yu, T. Tao, S. Mateti, S. Lu and Y. Chen, *Advanced Functional Materials*, 2018, **28**, 1803023.
6. M. Zhu, B. Li, S. Li, Z. Du, Y. Gong and S. Yang, *Advanced Energy Materials*, 2018, **8**, 1703505.
7. Y. Y. Liu, D. C. Lin, Z. Liang, J. Zhao, K. Yan and Y. Cui, *Nat. Commun.*, 2016, **7**, 9.