Supporting Information

Interfacial superassembly of $MoSe_2$@Ti_2N MXene hybrids enabling promising lithium-ion storage

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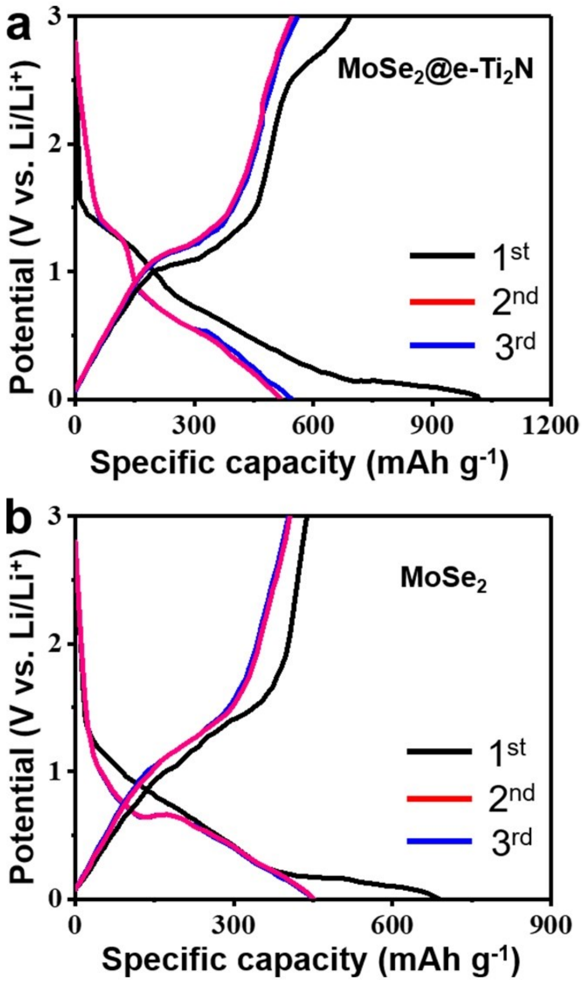

Fig. S1 Charge-discharge curves of $MoSe_2$@etched-Ti_2N (a) and $MoSe_2$ (b) at the current density of 0.1 A g^{-1} include the first three times. The initial coulomb efficiencies of $MoSe_2$@etched-Ti_2N and $MoSe_2$ are 65.8% and 63.9%, respectively.

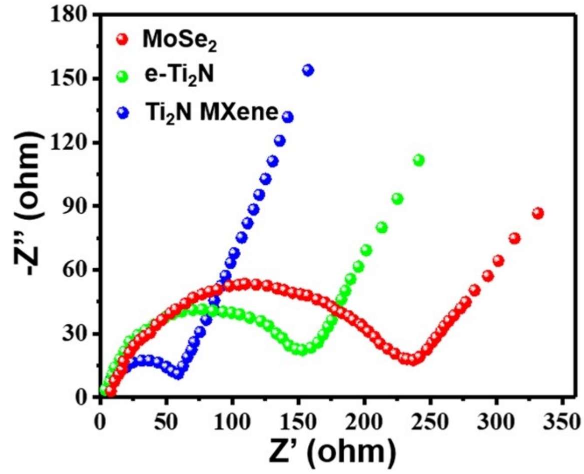

Fig. S2 EIS spectra of pure $MoSe_2$, e-Ti_2N and Ti_2N MXene as LIB anodes.

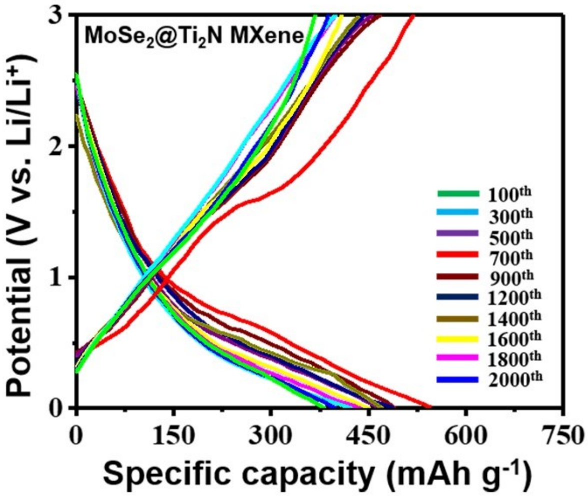

Fig. S3 Charge-discharge curves of $MoSe_2$@Ti_2N MXene at 1 A g^{-1}

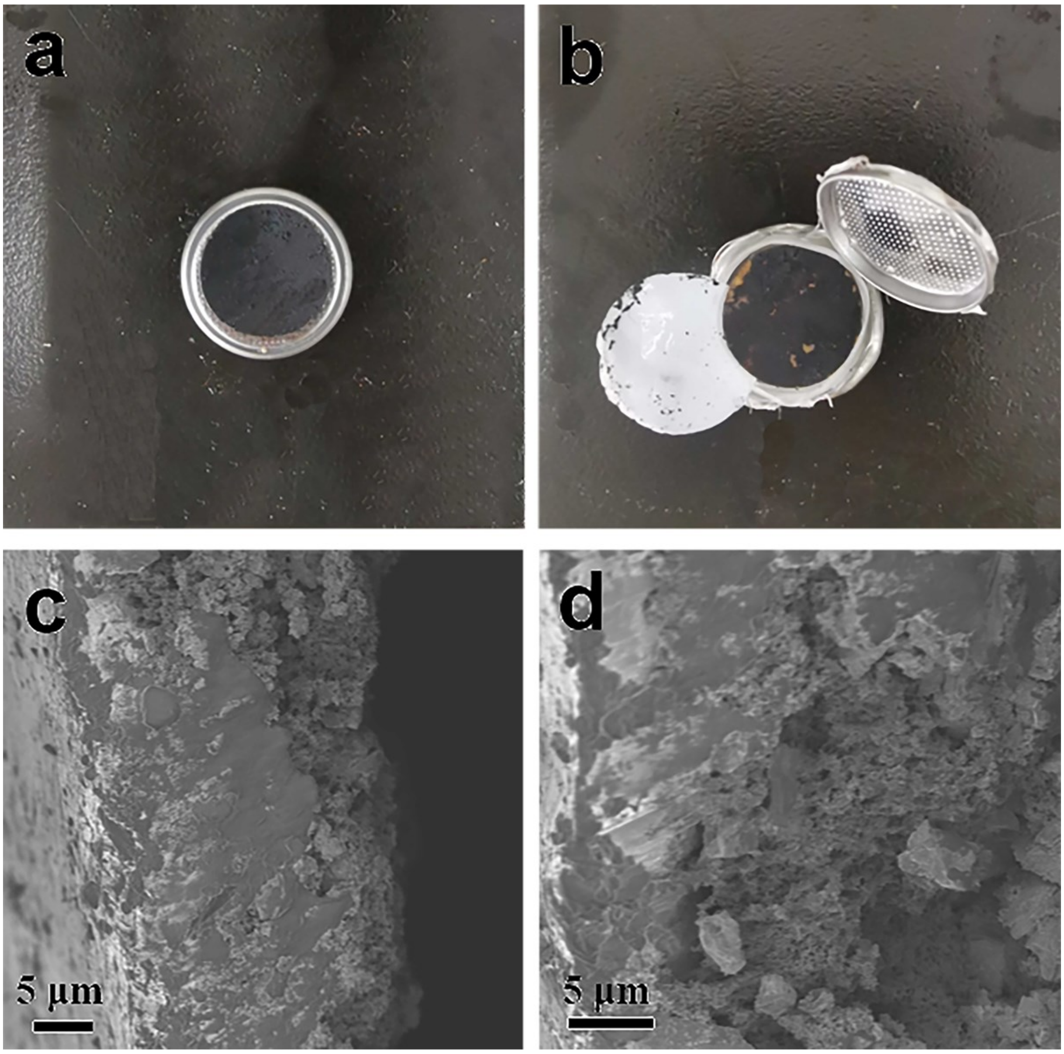

Fig. S4 (a) The digital picture of the anode before battery assembly. (b) The digital picture of anode after long-time cycling. (c, d) SEM images of anode materials before and after 2000 cycles.

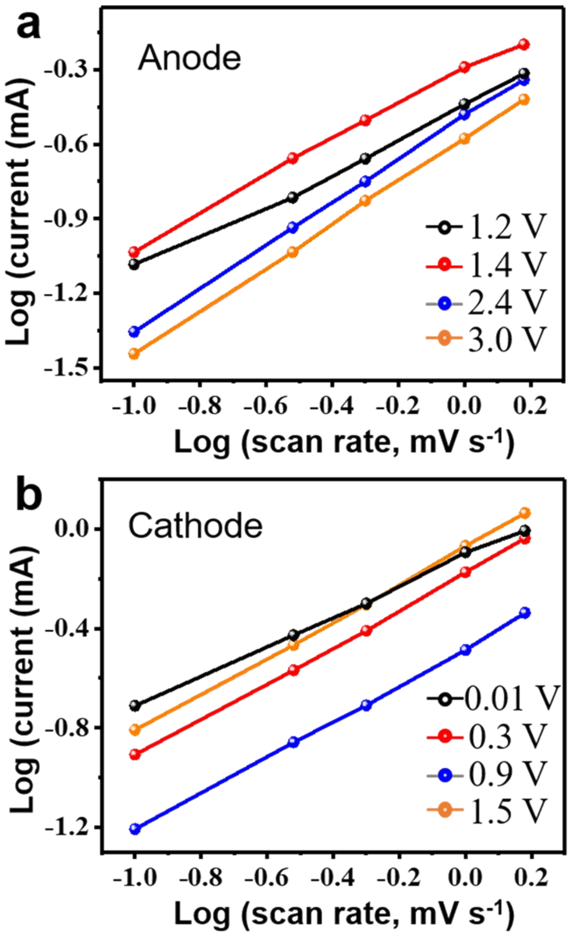

Fig. S5 Current response plotted against different scan rates of $MoSe_2$@Ti_2N MXene electrodes at different potentials for anodic scans (a) and cathodic scans (b).

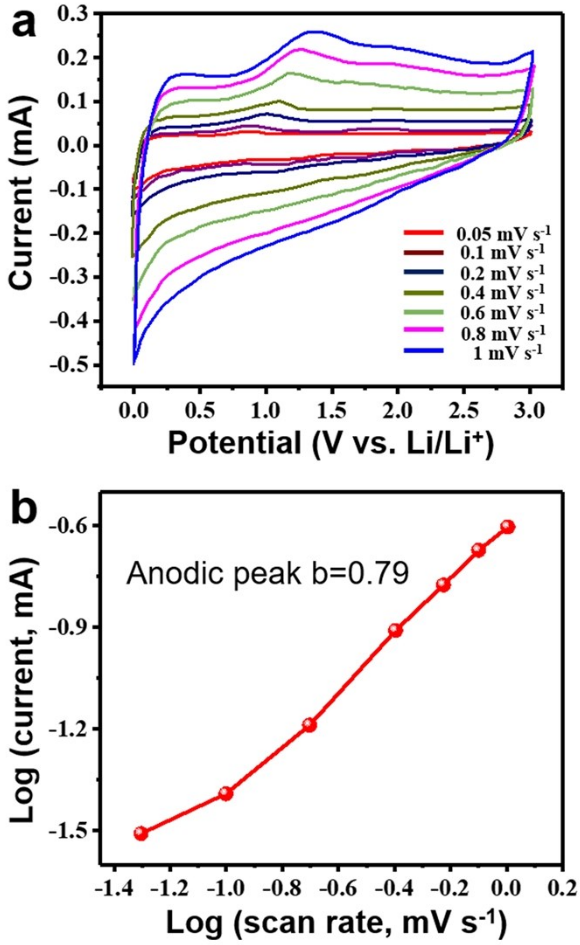

Fig. S6 (a) CV curves of pure Ti_2N MXene. (b) The relationship between scan rate and current of pure Ti_2N MXene.

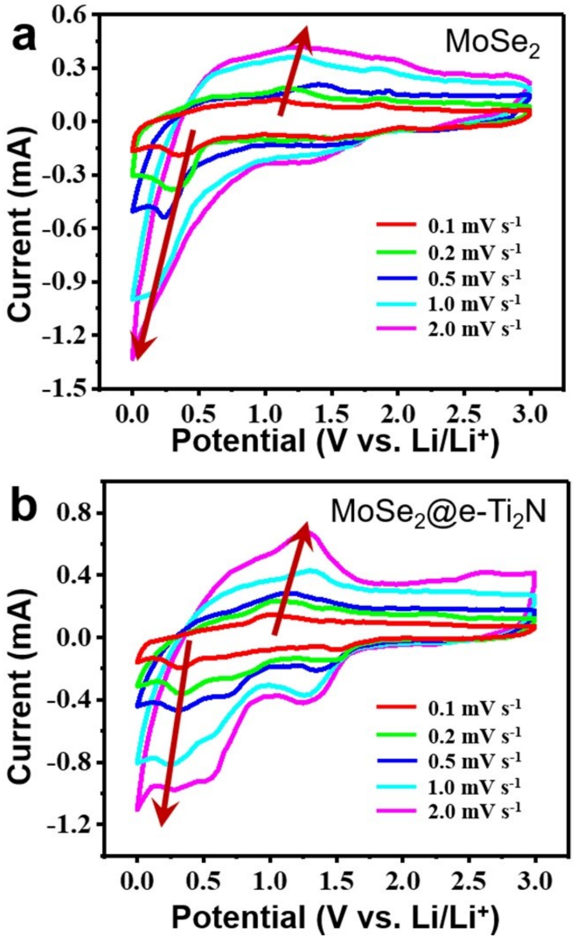

Fig. S7 CV curves of $MoSe_2$ (a) and $MoSe_2$@etched-Ti_2N (b).

Table S1 Comparisons of the electrochemical performance of other kinds of electrodes.

Materials	Performance		References
	Cycling*	Rate**	
$MoSe_2$@Ti_2N MXene	826/0.1/200th	240/5	This work
Ti_2C anode material	110/0.1/80th	89/3	[S1]
Delaminated Ti_3C_2 'paper'	410/0.1/100th	65/10	[S2]
$MoSe_2$-coverd N, P-doped Carbon nanosheets	378/0.5/1000th	216/15	[S3]
Nb_2CT_x/CNT composites paper	420/0.5/100th	288/10	[S4]
Ti_3C_2/TMO hybrid film electrodes	1200/0.1/100th	225/2	[S5]
MoS_2 Nanocrystal/Ti_3C_2 nanosheet Hybrids	835.1/0.5/110th	706.0/5	[S6]
$MoSe_2$ nanoflakes decorated rGO	955/0.1/270th	830/2	[S7]
Red $MoSe_2$	1125.7/1/500th	549.5/5	[S8]
Few-layer $MoSe_2$/Nitrogen-doped carbon	86/0.1/150th	76/2	[S9]
$MoSe_2$@C HNSs	711/0.2/300th	481/5	[S10]
$MoSe_2$@FC@Mo_2C	802/0.5/100th	789/5	[S11]

*: Capacity [mA h g^{-1}]/Current Density[A g^{-1}]/Cycles;

**: Capacity [mA h g^{-1}]/Current Density [A g^{-1}];

References

[S1] M. Naguib, J. Come, B. Dyatkin, V. Presser, P.-L. Taberna, P. Simon, M.W. Barsoum, Y. Gogotsi, MXene: a promising transition metal carbide anode for lithium-ion batteries, *Electrochem. Commun.*, **16** (2012) 61-64.

[S2] J. Come, M. Naguib, P. Rozier, M.W. Barsoum, Y. Gogotsi, P.L. Taberna, M. Morcrette, P. Simon, A Non-Aqueous Asymmetric Cell with a Ti_2C-Based Two-Dimensional Negative Electrode, *J. Electrochem. Soc.*, **159** (2012) A1368-A1373.

[S3] F. Niu, J. Yang, N. Wang, D. Zhang, W. Fan, J. Yang, Y. Qian, MoSe2-Covered N,P-Doped Carbon Nanosheets as a Long-Life and High-Rate Anode Material for Sodium-Ion Batteries, *Adv. Funct. Mater.*, **27** (2017) 1700522.

[S4] O. Mashtalir, M.R. Lukatskaya, M.Q. Zhao, M.W. Barsoum, Y. Gogotsi, Amine-Assisted Delamination of Nb_2C MXene for Li-Ion Energy Storage Devices, *Adv. Mater.*, **27** (2015) 3501-3506.

[S5] M.-Q. Zhao, M. Torelli, C.E. Ren, M. Ghidiu, Z. Ling, B. Anasori, M.W. Barsoum, Y. Gogotsi, 2D titanium carbide and transition metal oxides hybrid electrodes for Li-ion storage, *Nano Energy*, **30** (2016) 603-613.

[S6] Z. Hu, X. Kuai, J. Chen, P. Sun, Q. Zhang, H.H. Wu, L. Zhang, Strongly Coupled MoS_2 Nanocrystal/Ti_3C_2 Nanosheet Hybrids Enable High-Capacity Lithium-Ion Storage, *ChemSusChem*, **13** (2020) 1485-1490.

[S7] W. Tian, B. Xi, Z. Feng, H. Li, J. Feng, S. Xiong, Sulfiphilic Few-Layered $MoSe_2$ Nanoflakes Decorated rGO as a Highly Efficient Sulfur Host for Lithium-Sulfur Batteries, *Adv. Energy Mater.*, **9** (2019) 1901896.

[S8] S. Zhang, G. Wang, J. Jin, L. Zhang, Z. Wen, J. Yang, Robust and Conductive Red $MoSe_2$ for Stable and Fast Lithium Storage, *ACS Nano*, **12** (2018) 4010-4018.

[S9] C. Zheng, J. Wu, Y. Li, X. Liu, L. Zeng, M. Wei, High-Performance Lithium-Ion-Based Dual-Ion Batteries Enabled by Few-Layer $MoSe_2$/Nitrogen-Doped Carbon, *ACS Sustain. Chem. Eng.*, **8** (2020) 5514-5523.

[S10] X. Zhang, Y. Xiong, M. Dong, Z. Hou, Y. Qian, Construction of hierarchical $MoSe_2$@C hollow nanospheres for efficient lithium/sodium ion storage, *Inorg. Chem. Front.*, **7** (2020) 1691-1698.

[S11] Y. Xiao, Y. Liu, G. Qin, P. Han, X. Guo, S. Cao, F. Liu, Building $MoSe_2$-Mo_2C incorporated hollow fluorinated carbon fibers for Li-S batteries, *Compos. Part B: Eng.*, **193** (2020) 108004.