Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

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Supporting Information

Bifunctional Effect of Laser-Induced Nucleation-Preferable Microchannels and *in-situ* formed LiF SEI in MXene for Stable Lithium-Metal Batteries

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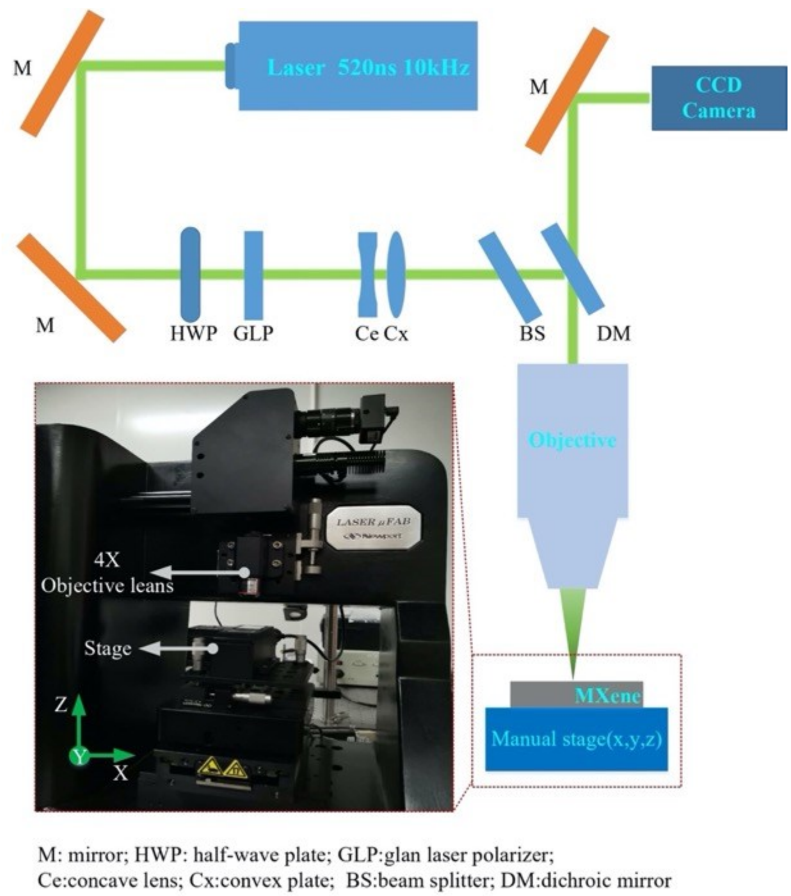

Fig S1. Femtosecond laser processing system.

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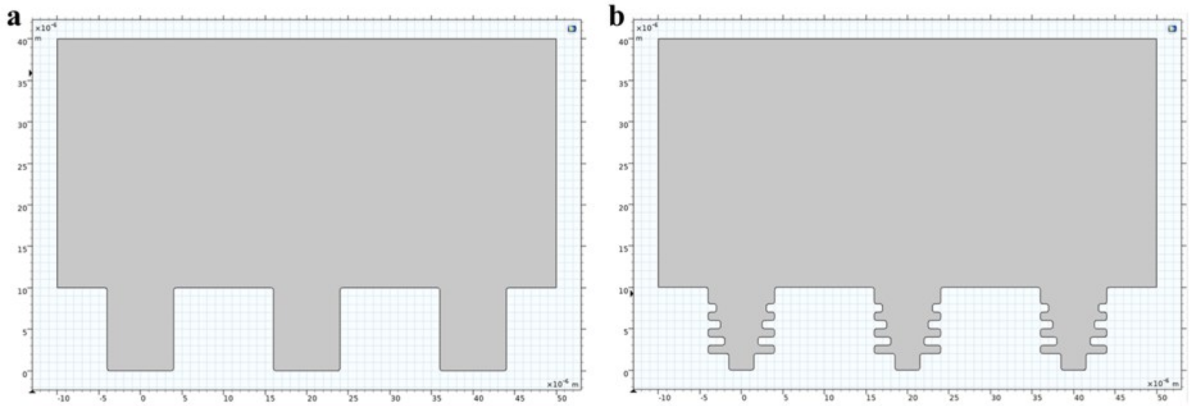

Fig S2. Simulation domain (a) without layer structure, (b) with layer structure inside the microchannels. In this simulation, the upper surface was set as Li/Li+ counter and reference electrode, and the bottom surface was our designed electrodes.

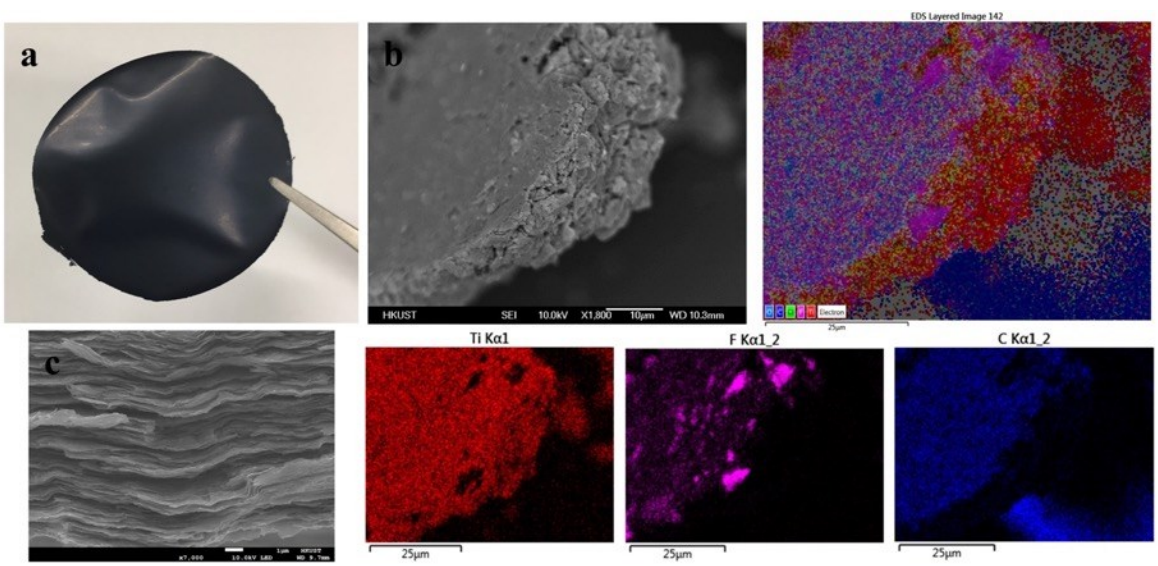

Fig S3. (a) Digital photo of prepared freestanding MXene, (b) SEM and corresponding EDS of etched MXene; (c) Cross-section of planar MXene.

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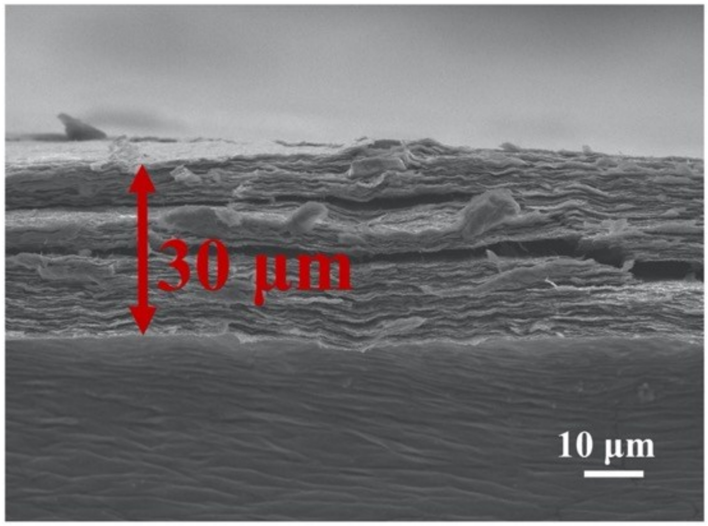

Fig S4. SEM image of MXene membrane.

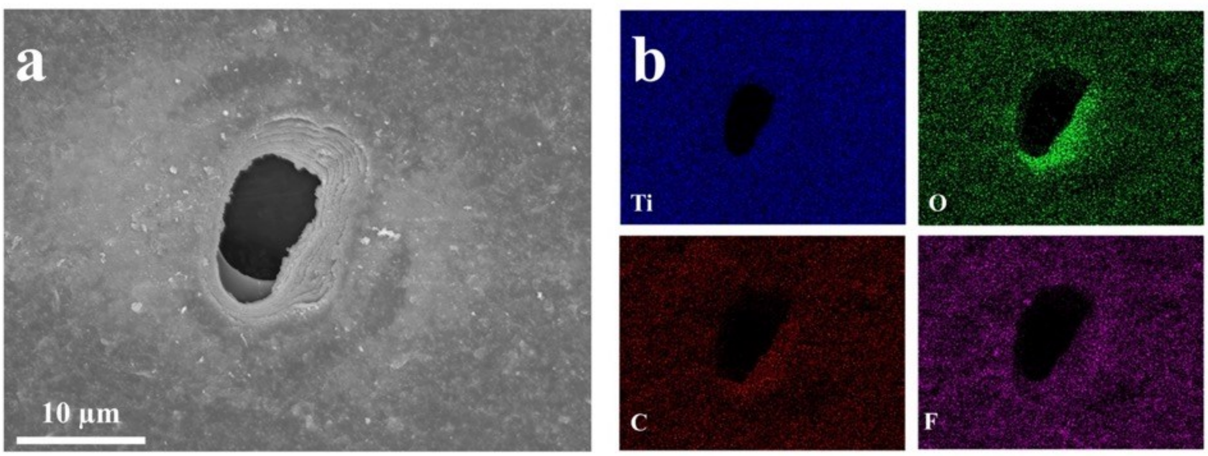

Fig S5. (a) High magnificent SEM images of Laser-treated MXene, and (b) corresponding energy dispersive spectrums (Ti, O, C, F).

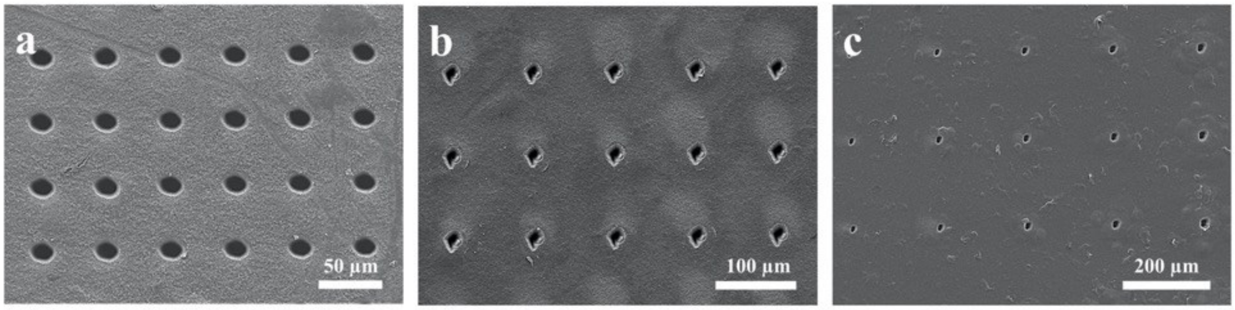

Fig S6. SEM images of (a) Laser-MXene-50, (b) Laser-MXene-100, and (c) Laser-MXene-200.

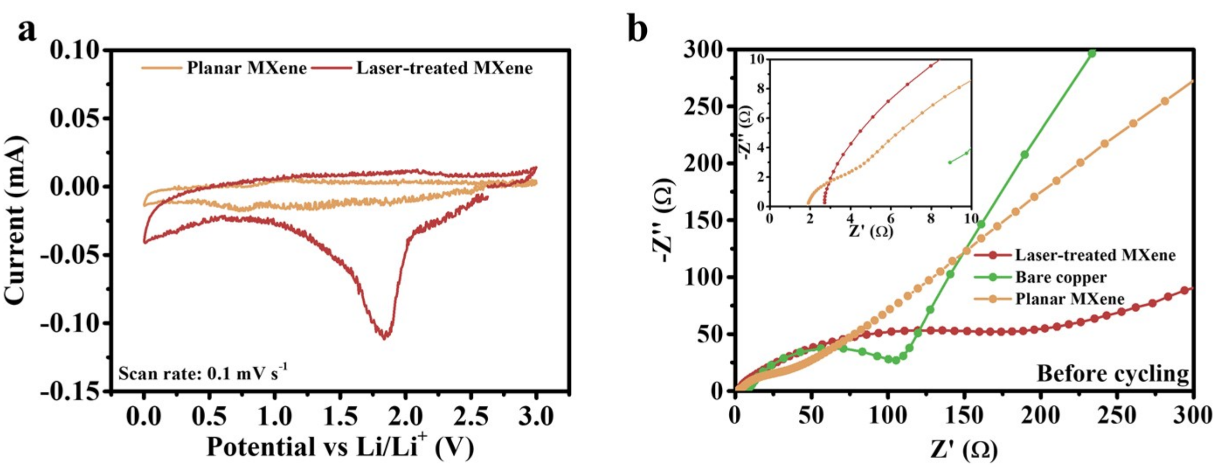

Fig S7. (a) CV; (b) EIS before cycling.

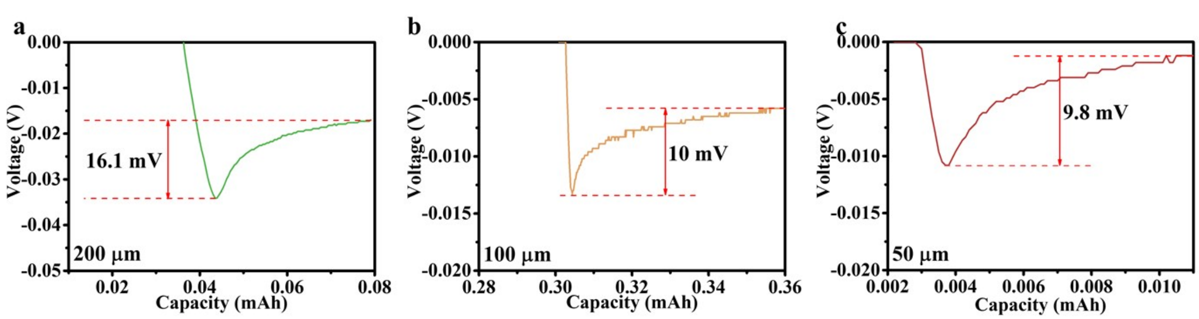

Fig S8. Nucleation overpotential of different spacings: (a) 200 μm, (b) 100 μm, and (c) 50 μm.

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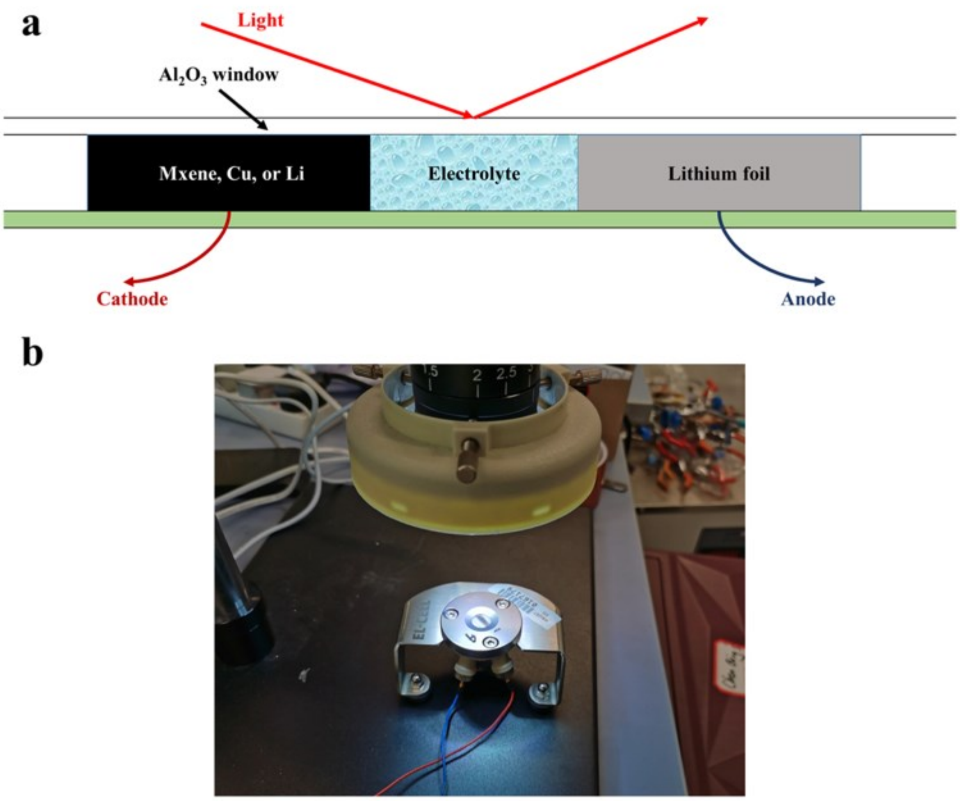

Fig S9. (a) Schematic showing the configuration of the optically transparent cell; (b) Image of cell undergoing *operando* plating/stripping with a current of 0.2 mA in the microscope.

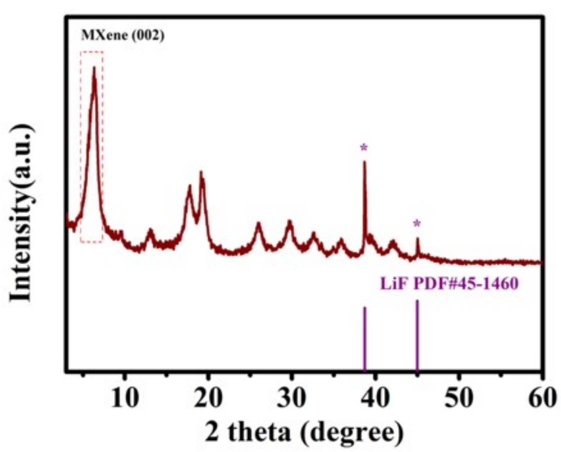

Fig S10. X-ray diffraction (XRD) spectroscopy of planar MXene after lithium deposition

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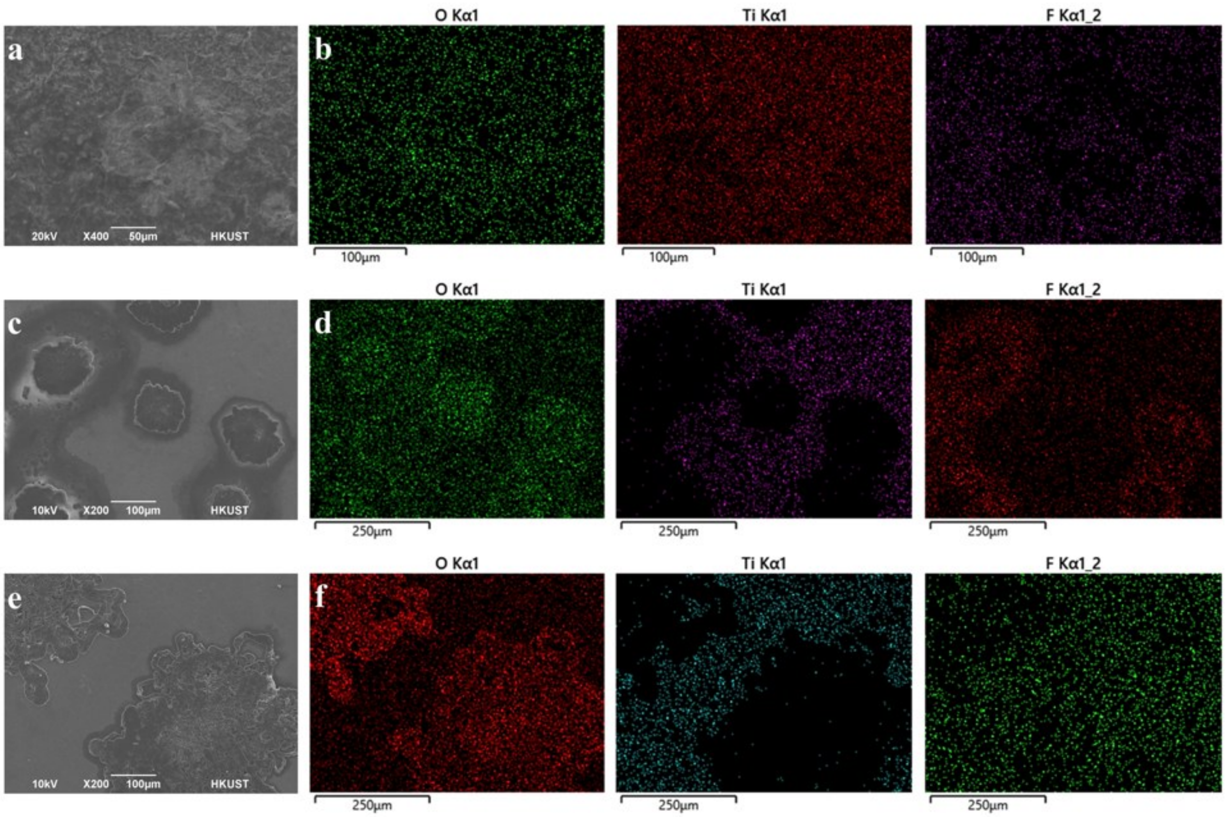

Fig S11. SEM and corresponding EDS of planar MXene with different deposition amount (a, b) 2 mAh cm^{-2}, (c, d) 4 mAh cm^{-2}, and (e, f) 6 mAh cm^{-2}.

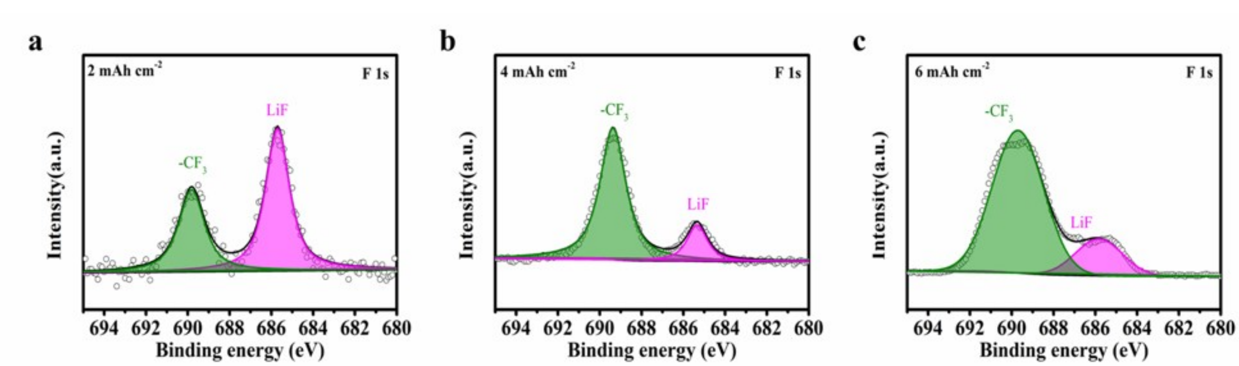

Fig S12. XPS analysis of planar MXene with different capacities (a) 2 mAh cm^{-2}, (b) 4 mAh cm^{-2}, and (c) 6 mAh cm^{-2}.

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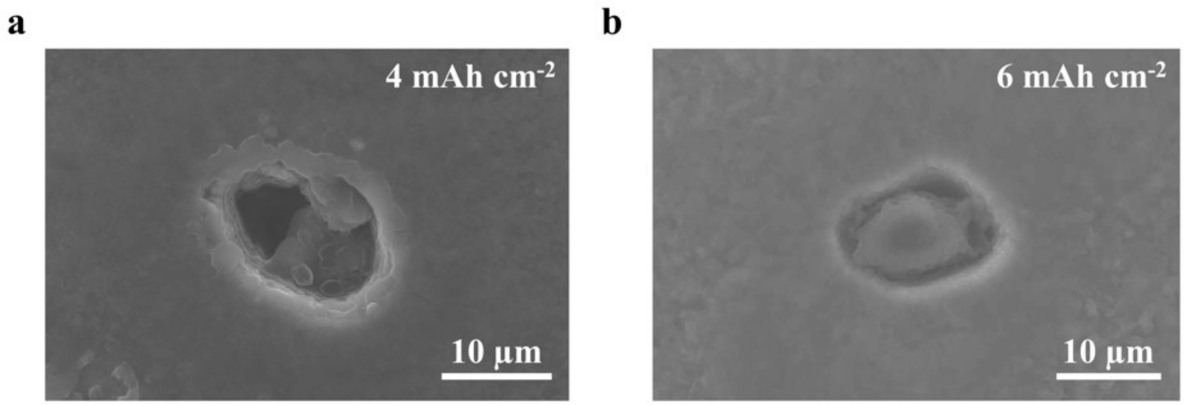

Fig S13. SEM images of the backside of laser-treated MXene with different plating capacities: (a) 4 mAh cm^{-2} and (b) 6 mAh cm^{-2}.

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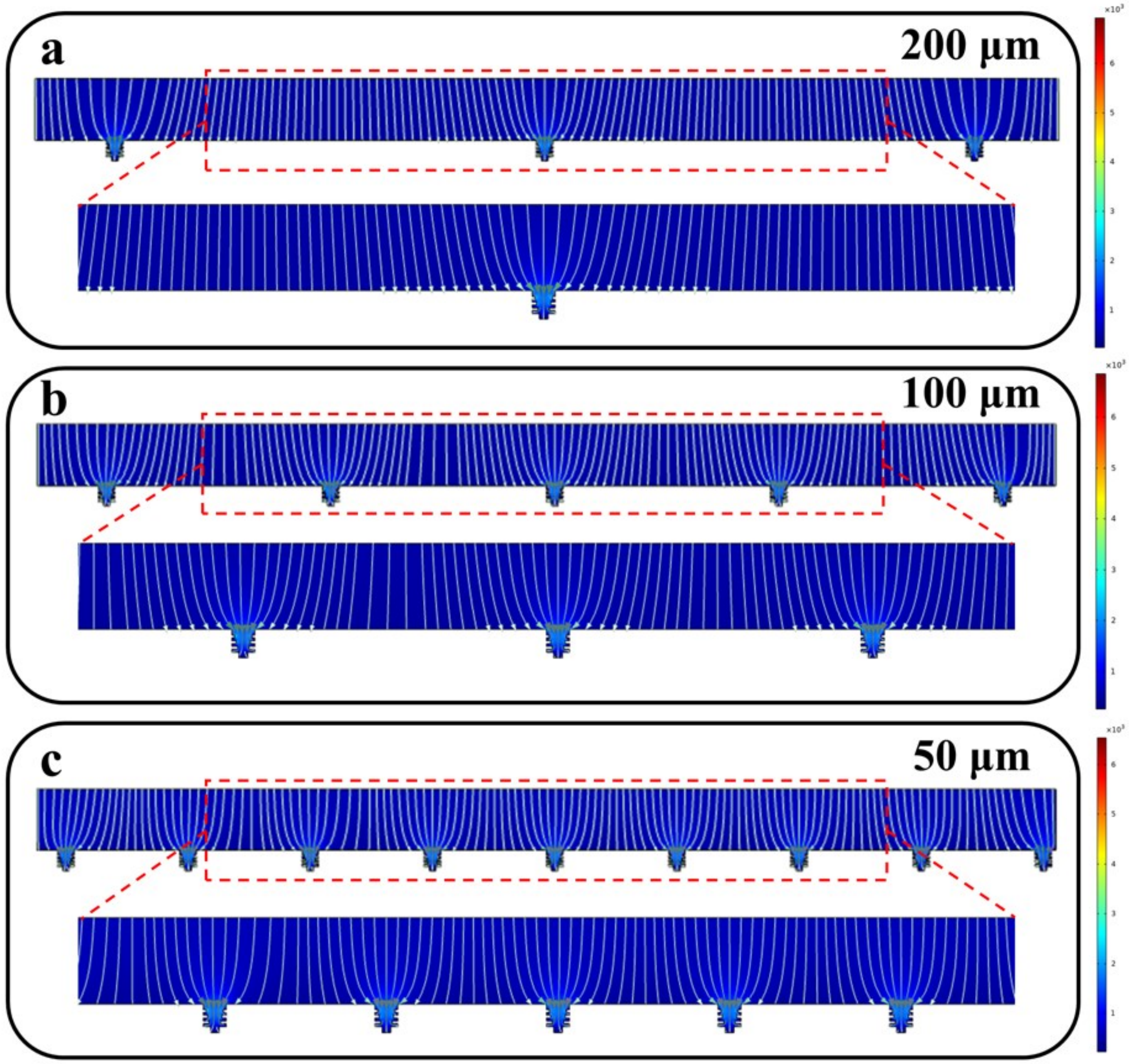

Fig S14. FEM simulations for different laser-treated MXene with various spacings: (a) 200 µm, (b) 100 µm, and (c) 50 µm. (Unit: A/m^2)

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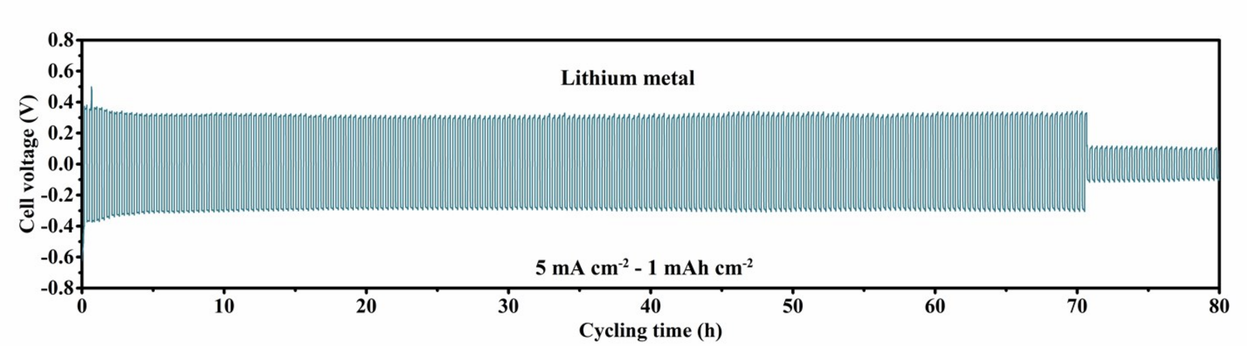

Fig S15. Cycling performance of symmetric cell with lithium metal at 5 mA cm^{-2} and 1 mAh cm^{-2}.

Table S1 Comparison with the other reported works.

	Current density [mA cm^{-2}]	Coulombic efficiency [%]	Cycle number	Reference
g-C_3N_4 Li^+-Modulating Layer	1	98	1000	[1] Guo *et al.*
	2	98	150	
	3	98	150	
	5	96	300	
Carbon nanofiber	1	99	300	[2] Zhang *et al.*
	2	98	300	
A carbon-based 3D current collector	1	90	80	[3] Zhang *et al.*
Stretchable Lithium Metal Anode	1	97.5	180	[4] Liu *et al.*
	2	96	50	
Inexpensive, Naturally Multi-	1	98.9	240	[5] Jin *et al.*
	2	97.4	180	
	3	96.7	120	
Nanochannel Confinement	1	97.6	225	[6] Liu *et al.*

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	2	92.9	150	
	3	88.6	130	
Protective Layer	0.5	97.2	120	[7] Xu *et al.*
	1	96.3	60	
Gradient-Distributed Nucleation Seeds	0.5	98.1	700	[8] Nan *et al.*
	1	96.8	200	
	3	96.1	200	
	5	96	200	
Conductive Nanostructured Scaffolds	0.5	97	50	[9] Zhang *et al.*
	2	95	50	
3D fluorine-doped graphene	1	99	300	[10] Li *et al.*
	2	98	150	
Our work	1	98.5	750	
	3	97.7	320	
	5	97.5	300	
	10	97.2	300	
	20	95.9	500	

Reference

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