Electronic Supplementary Material (ESI) for Materials Chemistry Frontiers.

Supplementary Information

Constructing robust and freestanding MXene/Si@C core-shell nanofibers via coaxing electrospinning for high performance Li-ion batteries

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Supplementary Figures

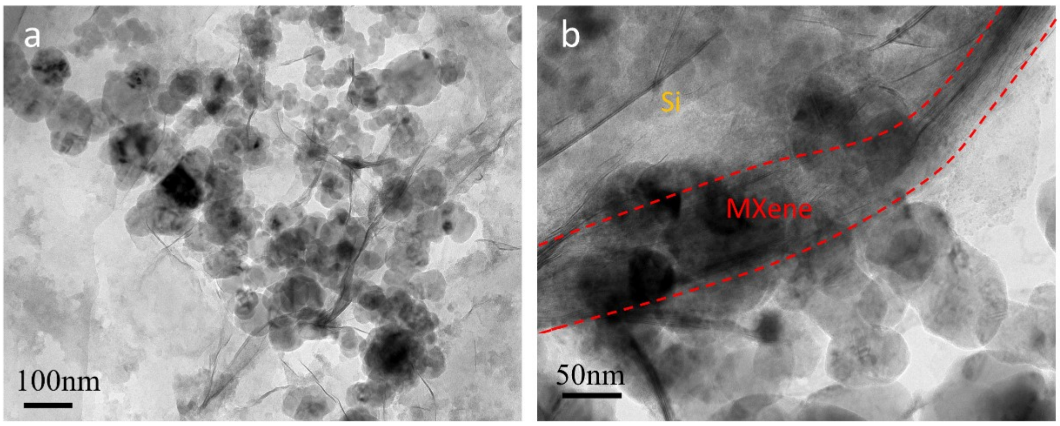

Figure S1. a) The SEM of MXene/Si after stirring 1h in DMF/acetone (1:1=w:w). b) Magnified SEM of MXene/Si contact part.

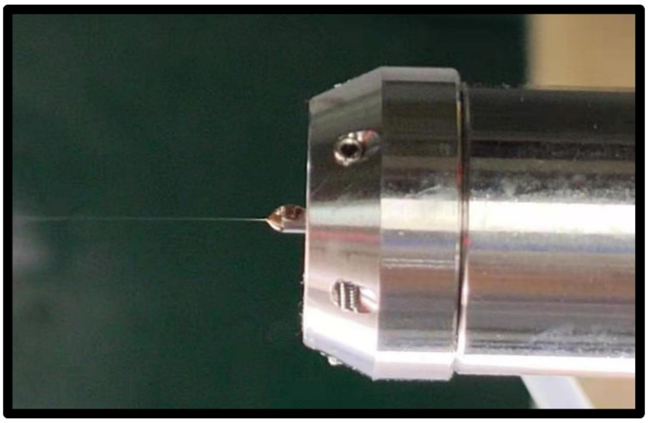

Figure S2. The coaxing nozzle and Tylor core during electrospinning.

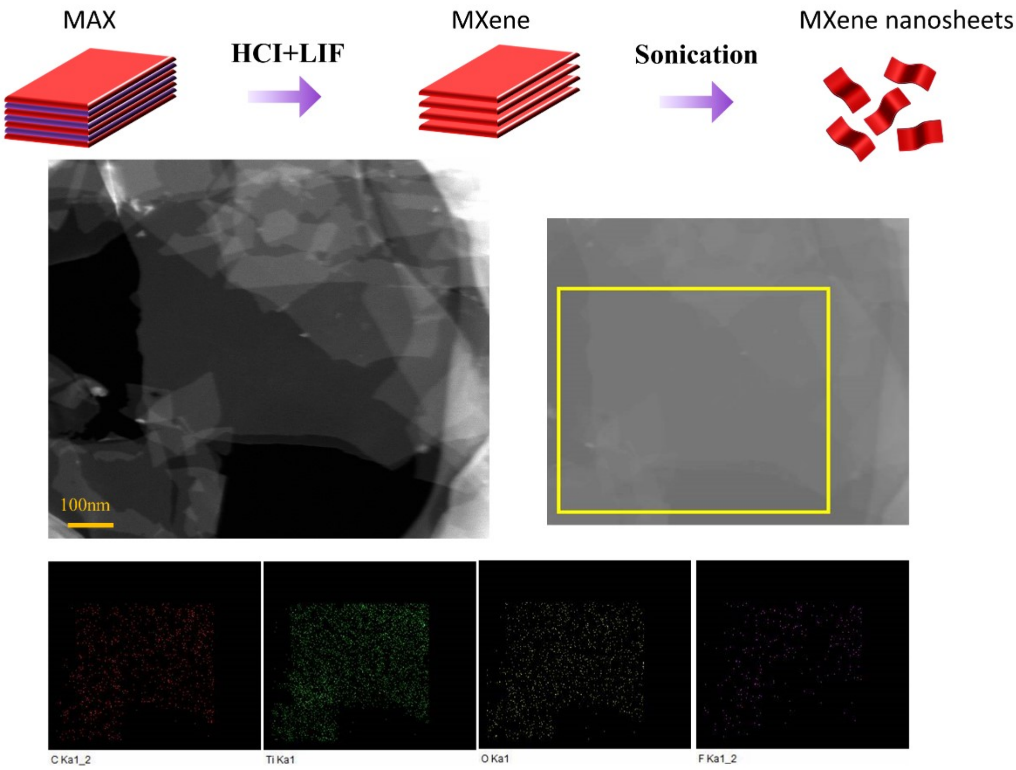

Figure S3. Synthesis of MXene and elemental mapping of MXene.

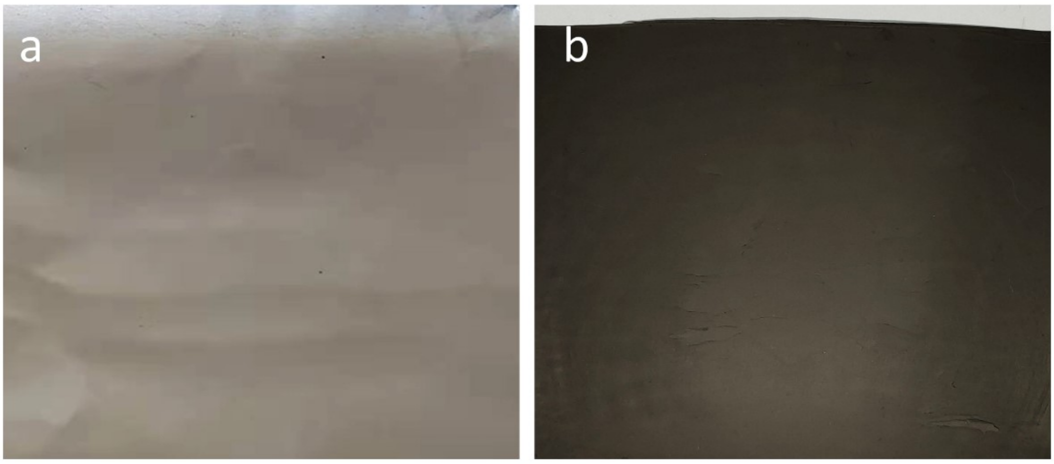

Figure S4. a) Electrospun MXene/Si/PMMA@PAN precursor film. b) MXene/Si@C film after carbonization at 700℃.

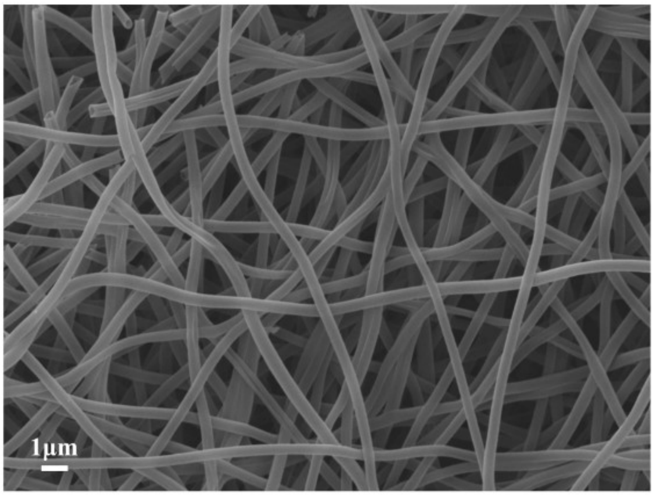

Figure S5. SEM of hollow carbon nanofibers carbonized at 700℃.

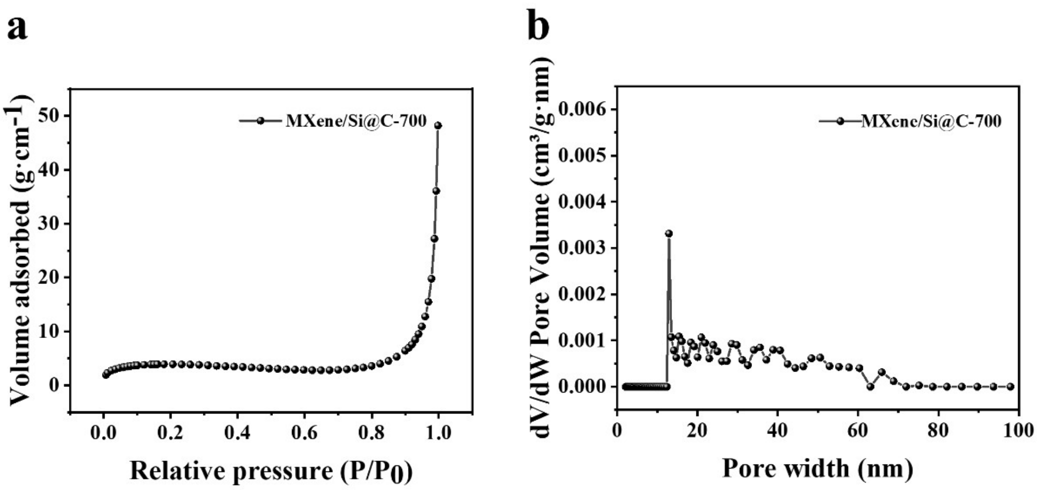

Figure S6. (a) Nitrogen adsorption−desorption isotherms of MXene/Si@C-700 (b) Corresponding pore diameter distributions.

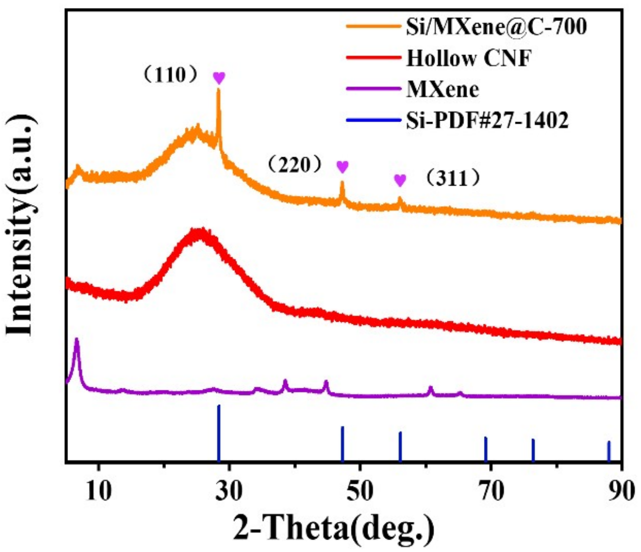

Figure S7. XRD pattern of MXene/Si@C-700, Hollow CNF and MXene.

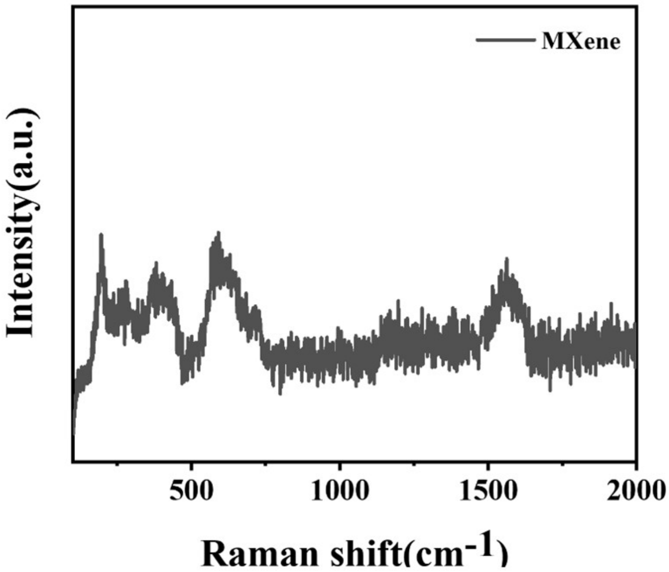

Figure S8. Raman spectrum of MXene.

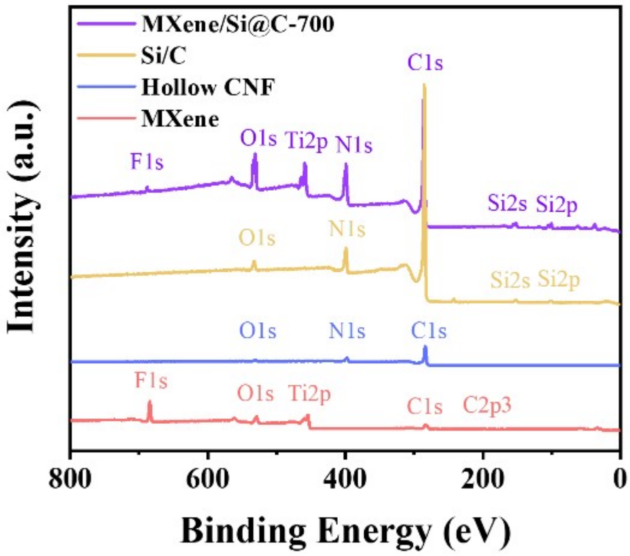

Figure S9. a) Typical XPS profile of the MXene/Si@C-700, Si/C, hollow CNF and MXene.

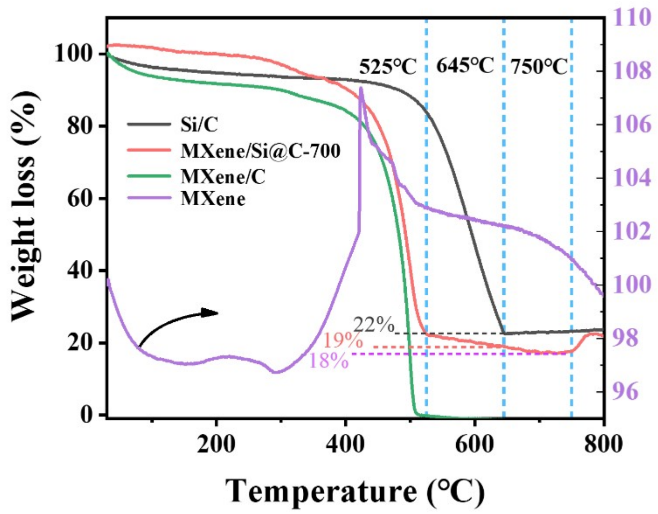

Figure S10. TGA curves of MXene/Si@C-700, Si/C nanofiber, MXene/C nanofiber and MXene.

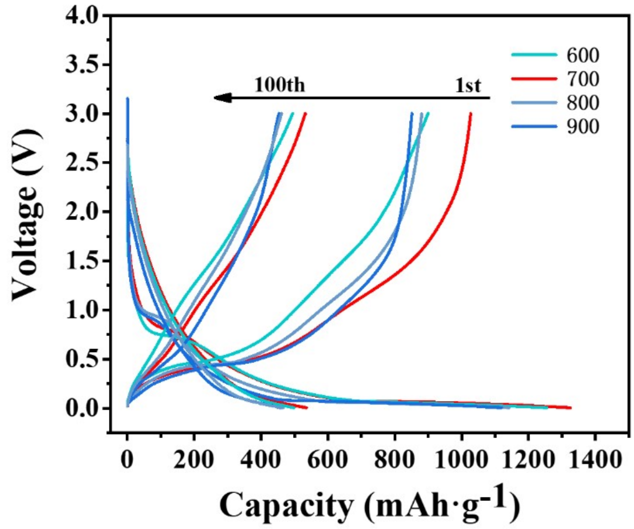

Figure S11. The initial and 100th galvanostatic charge/discharge profiles of MXene/Si@C carbonized at different temperatures (600, 700, 800, 900℃).

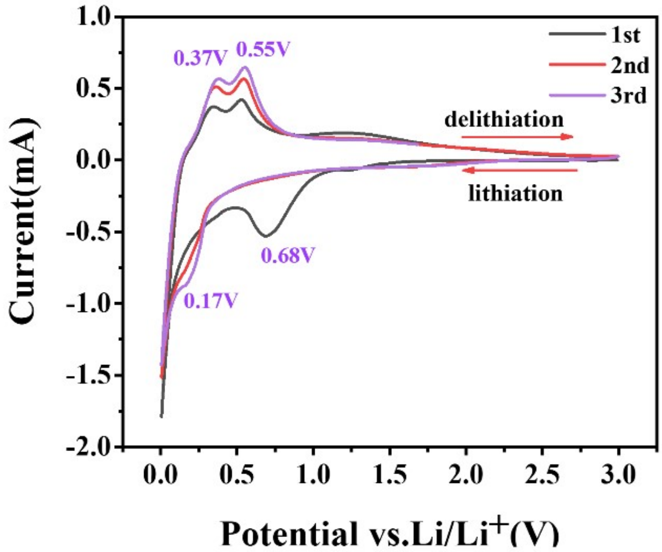

Figure S12. Initial three CV curves of Si/C electrode.

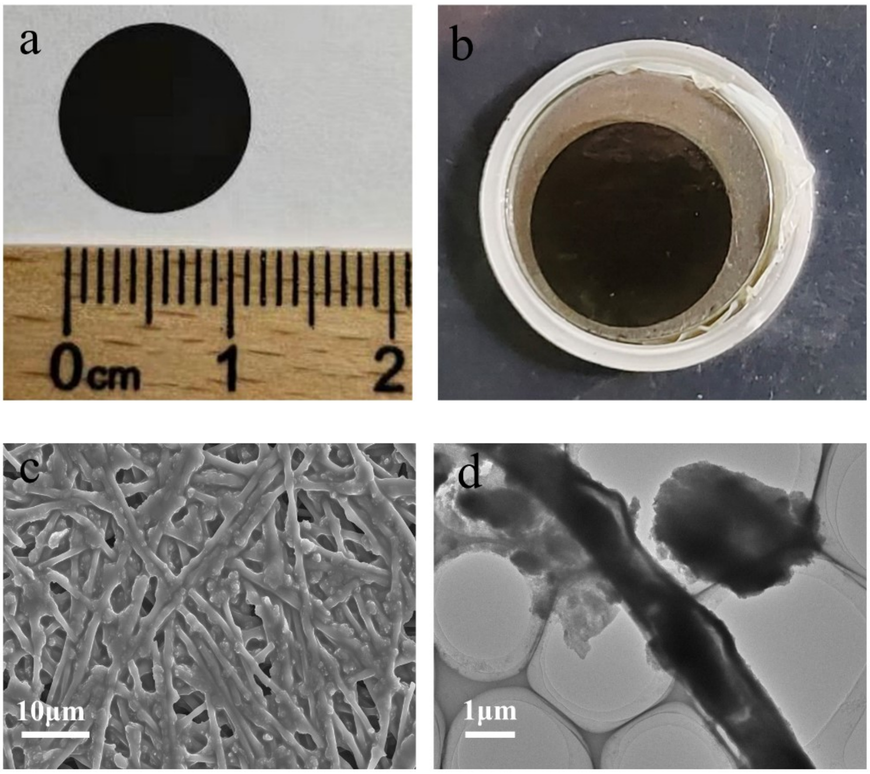

Figure S13. a) MXene/Si@C-700 electrode. b) MXene/Si@C-700 electrode after 1000 cycles at 1 A g^{-1} c) SEM of MXene/Si@C-700 nanofibers after1000 cycles at 1 A g^{-1} d) TEM of MXene/Si@C-700 nanofibers after1000 cycles at 1 A g^{-1}

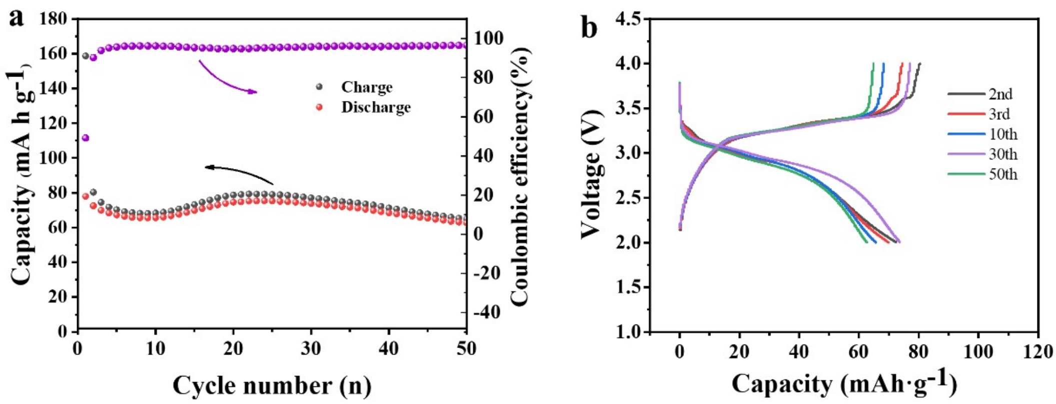

Figure S14. a) Cycling performance of LFP||MXene/Si@C-700 full cell at 0.1A g^{-1}. b) Corresponding galvanostatic charge/discharge profiles

In order to demonstrate the potential in practical application, full cells were constructed with MXene/Si@C-700 as anode and $LiFePO_4$ as cathode. As show in Figure S14 a,b, the full cell shows a voltage platform of about 3.2V with an initial reversible capacity of 80mAh g^{-1} and 67 mAh g^{-1} after 50 cycles. The gravimetric energy densities of the full cell based on the LFP||MXene/Si@C-700 is calculated to be 180Wh kg^{-1} in the initial cycle and150Wh kg^{-1} in the 50th cycle.[1]

The relative low energy densities is due to low ICE in the full cell, and it can be improved by prelithiation[2] or selecting proper electrolyte additives[3]. The coulombic efficiency keeps stable from the second cycle, which is ascribed to the stable core-shell structure and integrated conductive network.

Supplementary Table

Table S1. Lithium storage performance comparison between this work and previously reported Si-based and MXene-based anode materials.

	Si content (%)	Current density (A g^{-1})	Capacity (mAh g-1)	ICE （%）	Utilization efficiency （%）	Ref.

Si core/C shell	50	0.137	1305	87.5	55	4
Si/CNF@Graphene	29	0.1	1313	79.4	59	5
AG@Si@C	6.4	0.1	448	81.0	37	6
Si p-NS@TNSs	85.6	0.1	1498	80.2	41	1
Si core/C shell	9.9	0.05	596	61.6	67	7
Si@MXene	70	0.2	1797	74.7	58	8
Si/MXene	38.3	0.1	1316	61.1	70	9
MXene/Si@SiOx@C	72.8	0.84	1674	81.3	48	10
This Work	18	0.1	1083	78.4	86	

Supporting References

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