

# **Supporting information**

One-Step Hydrothermal Reaction induced Nitrogen-Doped MoS<sub>2</sub>/MXene  
Composites with Superior Lithium-Ion Storage

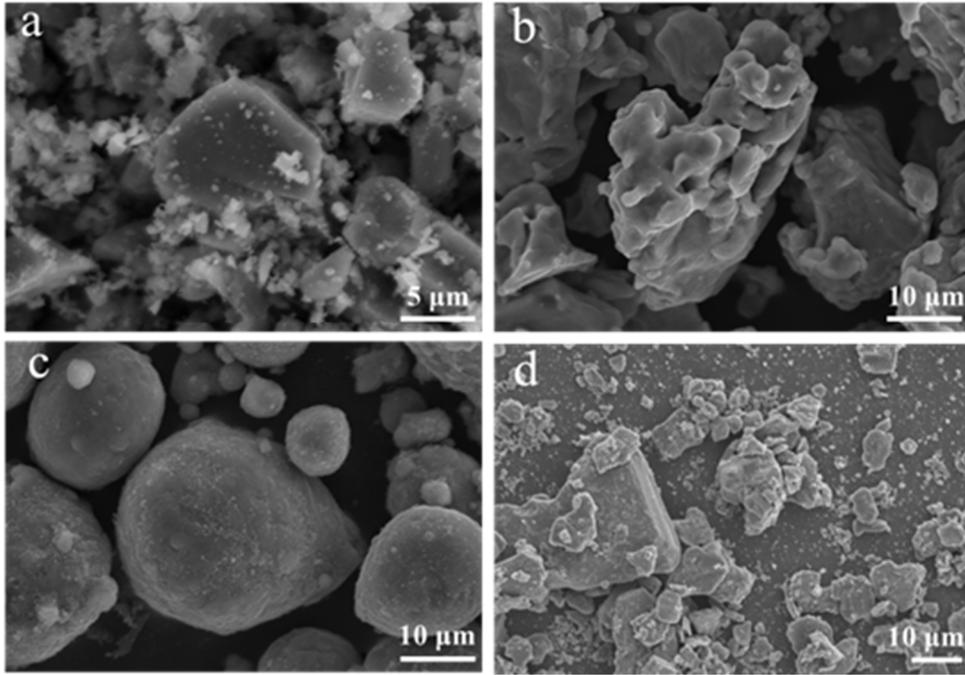


Figure S1. SEM images of (a) TiC; (b) Ti; (c)Al and (d) MAX.

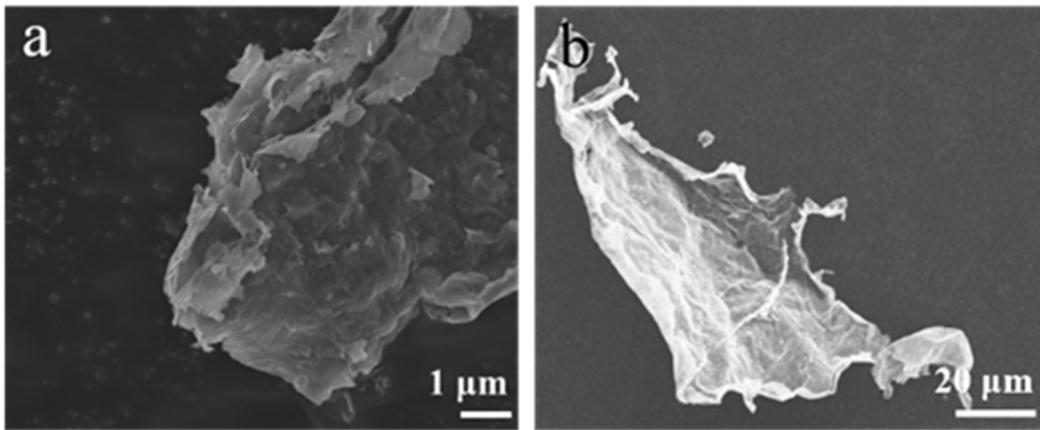


Figure S2. (a, b) SEM images of f-MXene

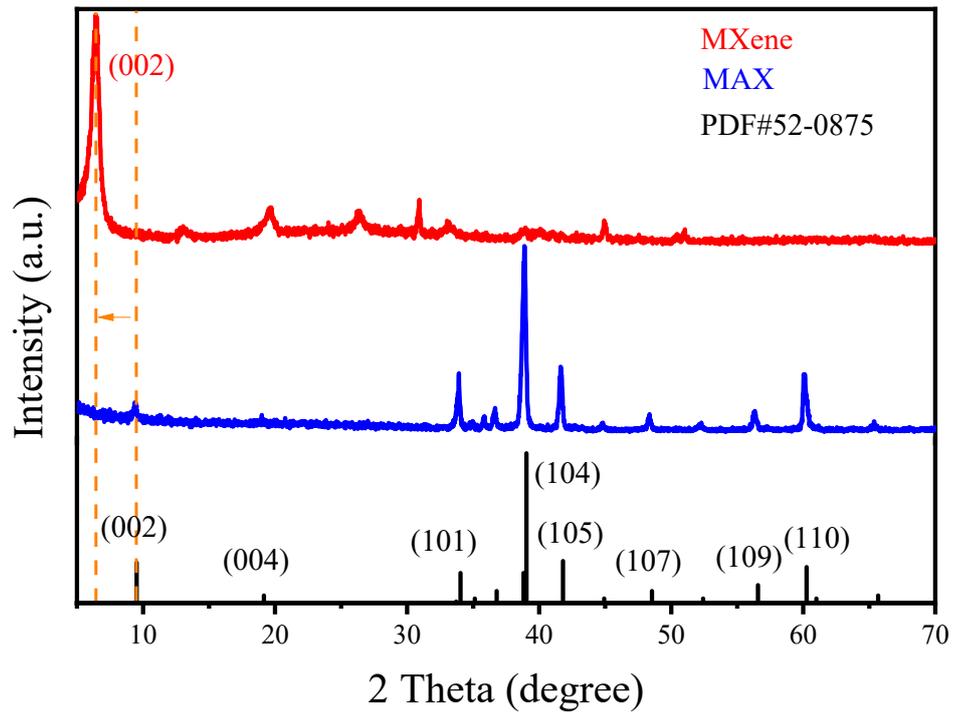


Figure S3. XRD patterns of MAX and MXene.

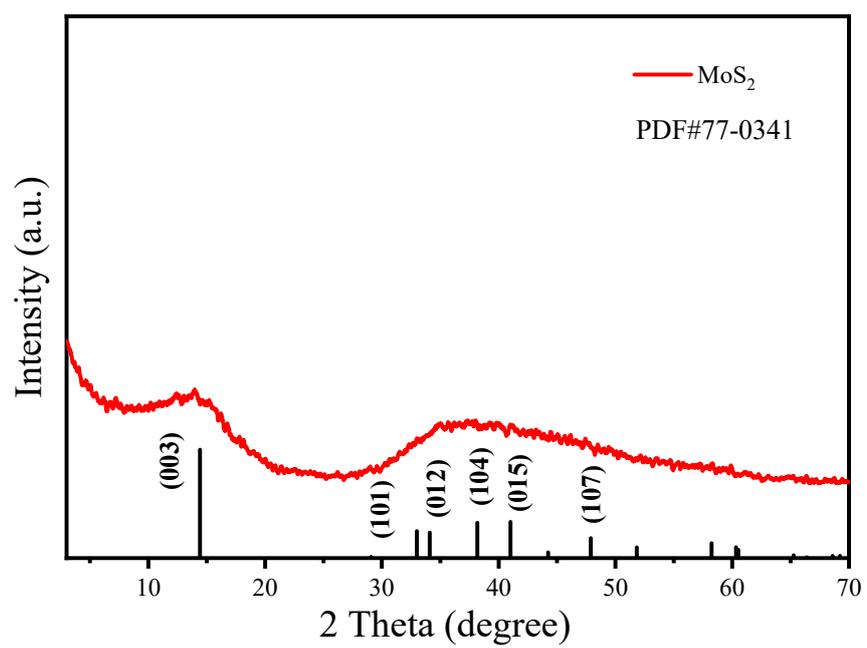


Figure S4. XRD pattern of MoS<sub>2</sub>

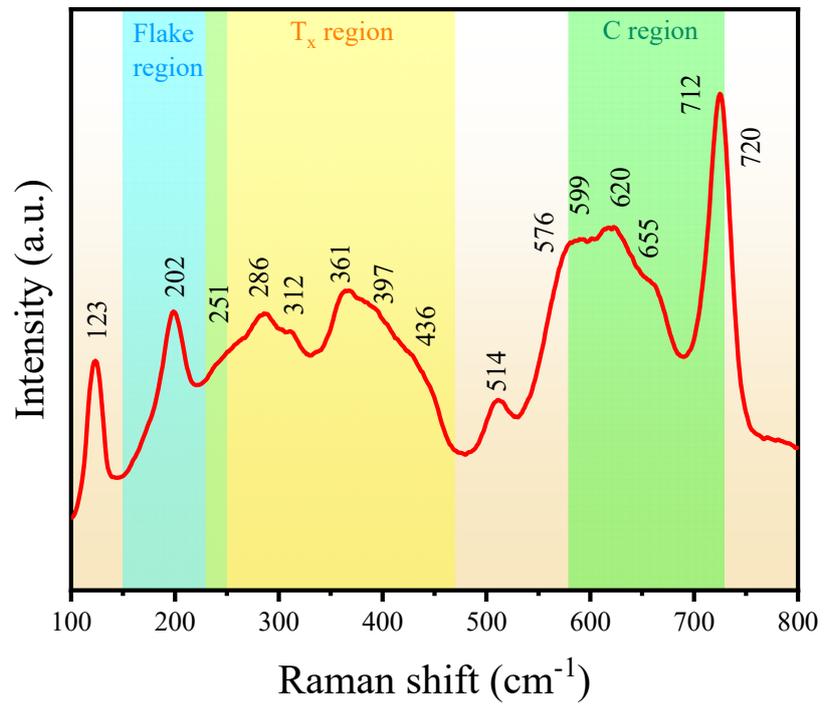


Figure S5. Raman spectrum of MXene.

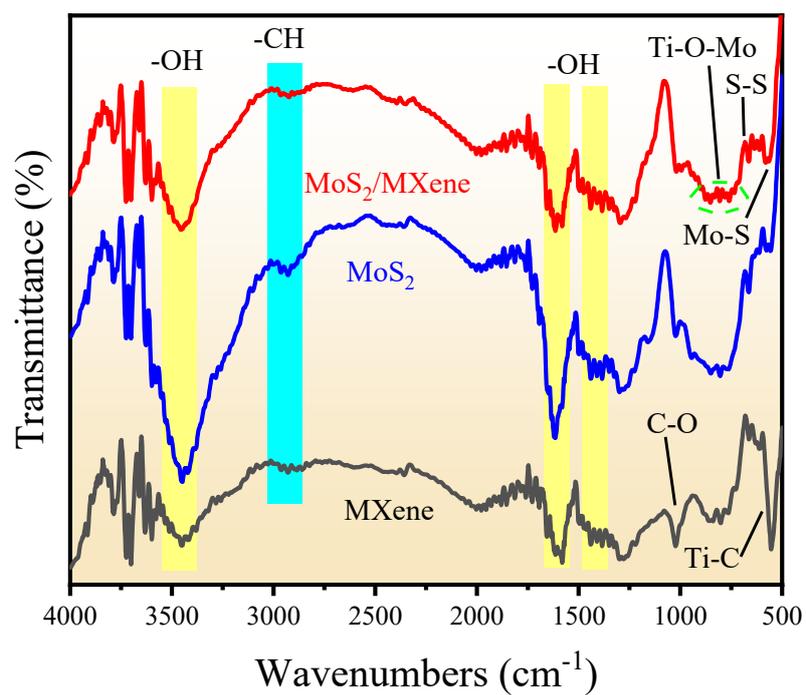


Figure S6. FTIR spectra of MXene,  $\text{MoS}_2$  and  $\text{MoS}_2/\text{MXene}$ .

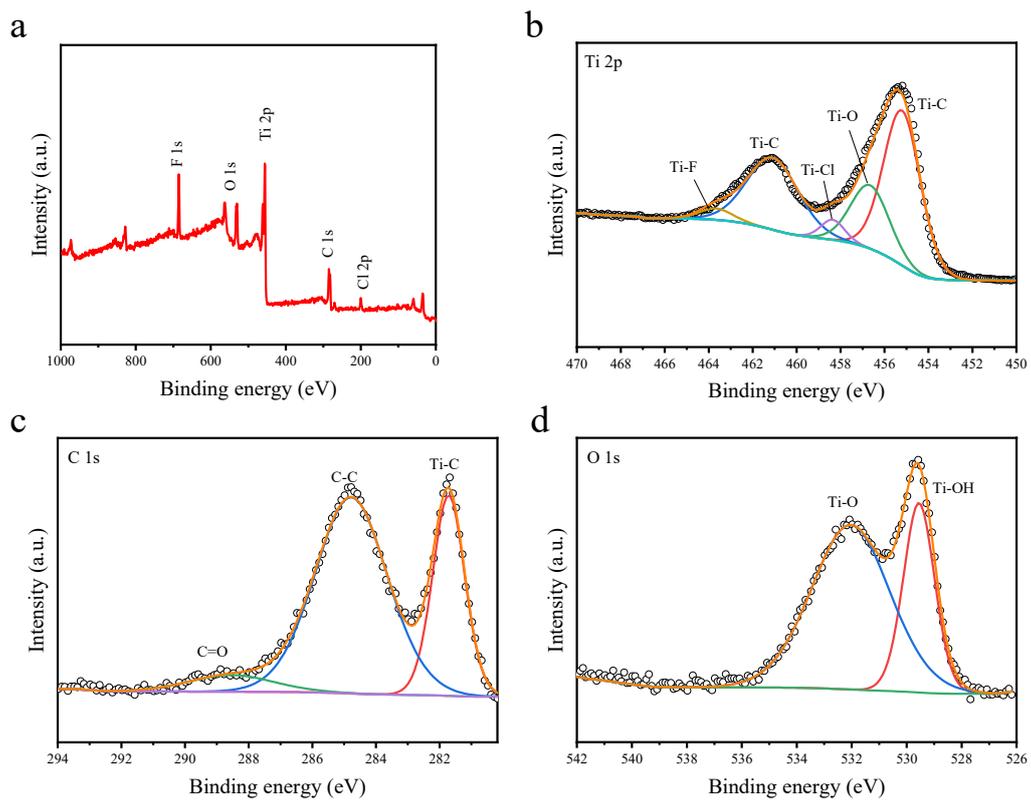


Figure S7. (a) Full XPS spectra of MXene; high-resolution XPS spectra of (b) Ti 2p; (c) C 1s and (d) O 1s.

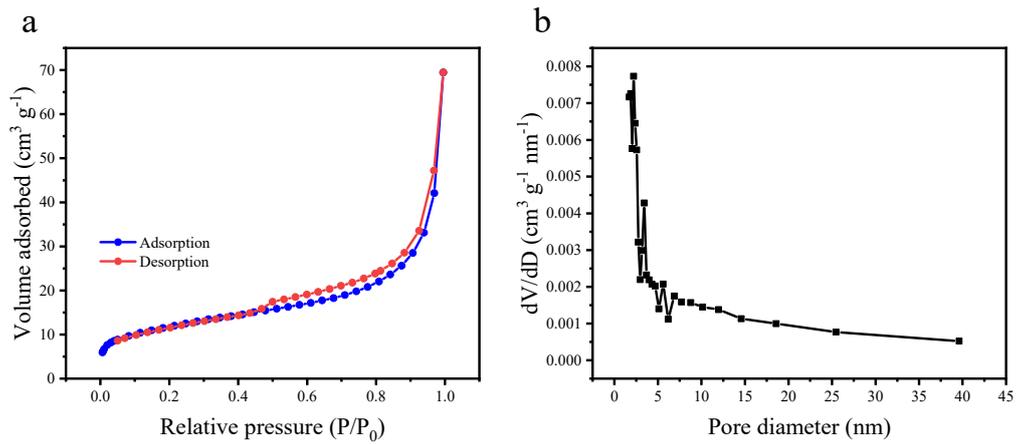


Figure S8. BET results of MoS<sub>2</sub>/MXene. (a) N<sub>2</sub> adsorption/desorption isothermal curve and (b) the pore size distribution curve.

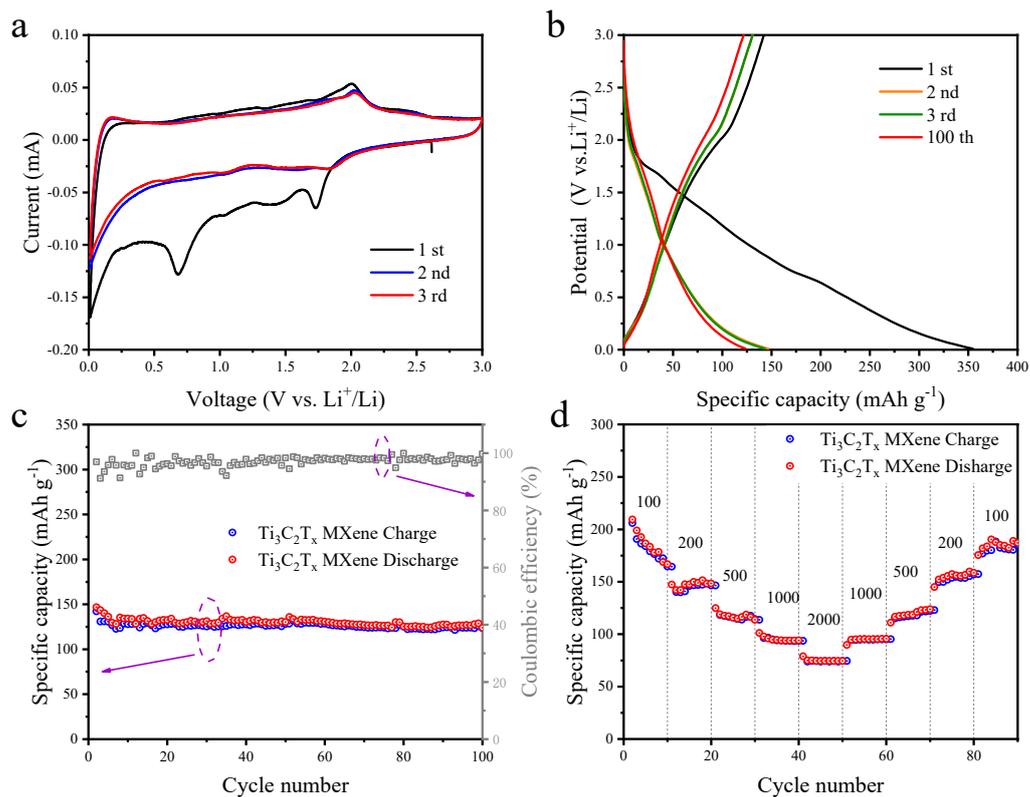


Figure S9. Electrochemical performance of  $\text{Ti}_3\text{C}_2\text{T}_x$  MXene: (a) Cyclic voltammetry curve at  $0.1 \text{ mV s}^{-1}$ ; (b) voltage curve at current density of  $100 \text{ mA g}^{-1}$ ; (c) charge and discharge cycling performance at current density of  $100 \text{ mA g}^{-1}$ ; (d) rate performance at different current densities.

The diffusion coefficient ( $D$ ) of all electrodes is calculated from the GITT potential profiles using Fick's second law with the following equation:

$$D = \frac{4}{\pi\tau} \left( \frac{m_B V_M}{M_B S} \right)^2 \left( \frac{\Delta E_S}{\Delta E_\tau} \right)^2$$

where  $\tau$  represents the duration of the current pulse;  $m_B$  is the mass loading of the electrode material;  $S$  is the geometric area of the electrode;  $\Delta E_S$  is the quasi-thermodynamic equilibrium potential difference between before and after the current pulse;  $\Delta E_\tau$  is the potential difference during the current pulse;  $V_M$  is the molar volume of active materials; and  $M_B$  is the molar mass of the electrode material.

Table S1. The source or manufacturer of materials

<b>Samples</b>	<b>Fineness</b>	<b>Manufacturers</b>
TiC	99.9%	Shanghai Pantian Powder Material Co., Ltd.
Ti	99.9%	Shanghai Pantian Powder Material Co., Ltd.
Al	99.9%	Shanghai Pantian Powder Material Co., Ltd.
NaCl	AR	Sinopharm Chemical Reagent Co., Ltd.
KCl	AR	Sinopharm Chemical Reagent Co., Ltd.
HCl	AR	Sinopharm Chemical Reagent Co., Ltd.
LiF	AR	Adamas
C <sub>2</sub> H <sub>6</sub> O <sub>2</sub>	AR	Adamas
C <sub>2</sub> H <sub>6</sub> O	AR	Greagent
MoCl <sub>5</sub>	GR	Adamas
CH <sub>3</sub> CSNH <sub>2</sub>	GR	Adamas
C	Cell grade	Chengdu Xianfeng Materials Co., Ltd.
CMC	CP	Sinopharm Chemical Reagent Co., Ltd.
N <sub>2</sub>	99.999%	Shanghai BOC Industrial Gases Co., Ltd.
Ar	99.999%	Shanghai BOC Industrial Gases Co., Ltd.
Celgard 2400	Cell grade	Celgard, LLC
Li	Cell grade	China Energy Lithium Co., Ltd.
Cu	Cell grade	Shenzhen Jingliang Copper Co., Ltd.
LiPF <sub>6</sub> in EC/DEC	Cell grade	Suzhou Duoduo Chemical Technology Co., Ltd.

Table S2. Atomic percentage of elements in the MoS<sub>2</sub> and MoS<sub>2</sub>/MXene composite materials.

<b>Sample</b>	<b>Mo (at.%)</b>	<b>S (at.%)</b>	<b>C (at.%)</b>	<b>O (at.%)</b>	<b>N (at.%)</b>
<b>MoS<sub>2</sub></b>	13.19	27.58	42.26	16.28	0.68
<b>MoS<sub>2</sub>/MXene</b>	11.4	22.65	40.54	18.83	3.2

Table S3. Elemental analysis results of MoS<sub>2</sub>/MXene-2:1; MoS<sub>2</sub>/MXene-3:1 MoS<sub>2</sub>/MXene and MoS<sub>2</sub>/MXene-5:1.

<b>Sample</b>	<b>Mo (wt.%)</b>	<b>S (wt.%)</b>	<b>Ti (wt.%)</b>
<b>MoS<sub>2</sub>/MXene-2: 1</b>	26.9511	28.7343	41.4058
<b>MoS<sub>2</sub>/MXene-3: 1</b>	25.7381	22.9376	22.5768
<b>MoS<sub>2</sub>/MXene</b>	35.3741	35.3040	13.0671
<b>MoS<sub>2</sub>/MXene-5: 1</b>	39.3769	39.1460	11.5303

Table S4. Discharge capacity of MoS<sub>2</sub>, MXene, MoS<sub>2</sub>/MXene-2:1, MoS<sub>2</sub>/MXene-3:1, MoS<sub>2</sub>/MXene and MoS<sub>2</sub>/MXene-5:1 electrodes at different current densities and cycles.

Sample	Discharge capacity (mA h g <sup>-1</sup> )								
	3 <sup>rd</sup>	13 <sup>th</sup>	23 <sup>th</sup>	33 <sup>th</sup>	43 <sup>th</sup>	53 <sup>th</sup>	63 <sup>th</sup>	73 <sup>th</sup>	83 <sup>th</sup>
<b>MoS<sub>2</sub></b>	919	754	587	471	363	466	539	669	797
<b>MXene</b>	199	142	118	96	75	95	117	153	183
<b>MoS<sub>2</sub>/MXene-2: 1</b>	578	473	392	315	237	311	364	448	500
<b>MoS<sub>2</sub>/MXene-3: 1</b>	777	688	628	571	473	523	603	779	791
<b>MoS<sub>2</sub>/MXene</b>	834	778	713	655	526	589	675	777	853
<b>MoS<sub>2</sub>/MXene-5: 1</b>	967	870	715	590	398	513	628	771	901

Table S5. Cross-reference to full names and abbreviations

<b>Acronyms and abbreviations</b>	<b>Full names</b>
TMD	Transition Metal Dichalcogenides
2D	Two-Dimensional
ICE	Initial Coulombic Efficiency
LIBs	Lithium-ion Batteries
MOs	Metal Oxides
MSs	Metal Sulfides
PEI	Polyethyleneimine
PTFE	Poly Tetra Fluoroethylene
EG	Ethylene Glycol
TAA	Thioacetamide
SEM	Scanning Electron Microscope
TEM	Transmission electron microscope
XRD	X-ray Diffraction
BET	Brunauer-Emmett-Teller
FTIR	Fourier Transform Infrared Spectroscopy
XPS	X-ray Photoelectron Spectroscopy
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
CMC	Carboxymethyl Cellulose
EC	Ethylene Carbonate
DEC	Diethyl Carbonate
GITT	Galvanostatic Intermittent Titration Technique
CV	Cyclic Voltammetry
EIS	Electrochemical Impedance Spectroscopy

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SEAD

Selected Area Electron Diffraction

HRTEM

High Resolution Transmission Electron Microscope

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