Supporting Information

Dual Modification of $Ti_3C_2T_x$ MXene Hybridization and Cut-off Voltage Adjustment for MoS_2 to Achieve Stable Sodium Storage Performance

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Material Characterization

The morphology and structure investigation for the $MoS_2/Ti_3C_2T_x$ and $Ti_3C_2T_x$ was conducted by filed-emission scanning electron microscopy (Zeiss_Supra55) and transmission electron microscopy (Tecnai 12). The phase structures of as-prepared samples were determined by X-ray diffraction patterns with D8 ADVANCE using Cu Kα radiation source (λ = 1.54056 Å). Raman spectra was collected by RM-1000 (Renishaw In Via). The surface chemical components of obtained samples were detected through the X-ray photoelectron spectroscopy measurements (ESCALAB 250Xi).

Electrochemical Measurement

For the fabrication of working electrode, desired MoS2/Ti3C2Tx, conductive agent (Super P), and binder (carboxymethyl cellulose) with a mass ratio of 8:1:1 was dispersed into deionized water and further ground to from a uniform slurry, which was then coated on a clean copper foil and vacuum dried at 100 °C overnight. In regard to the cell assembly, sodium foil and Whatman glass fiber were employed as the counter electrode and separator, separately. The electrolyte employed is 1.0 M NaPF6 in ethylene carbonate/diethyl carbonate (EC/DEC). The electrochemical tests were conducted on the LAND 2001A battery test system, and the cyclic voltammetry measurements were conducted on an electrochemical workstation (CHI 660B), and the electrochemical impedance spectra were also collected from the same workstation from 0.1 Hz to 1000 kHz.

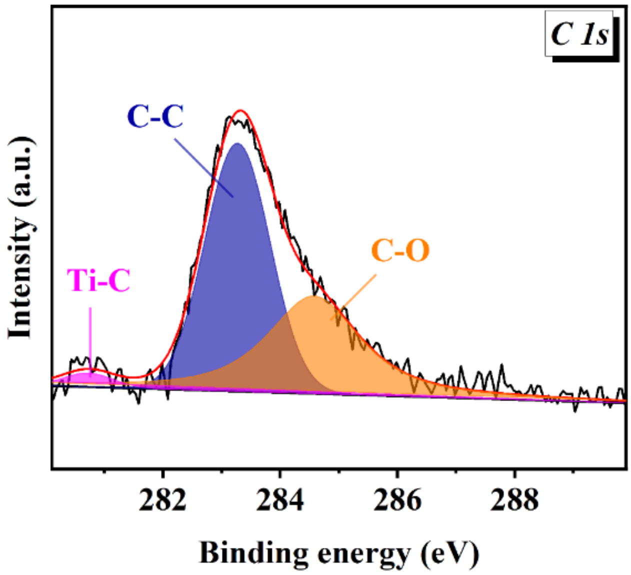

Fig. S1 High-resolution Ti 2p spectra of $MoS_2/Ti_3C_2T_x$.

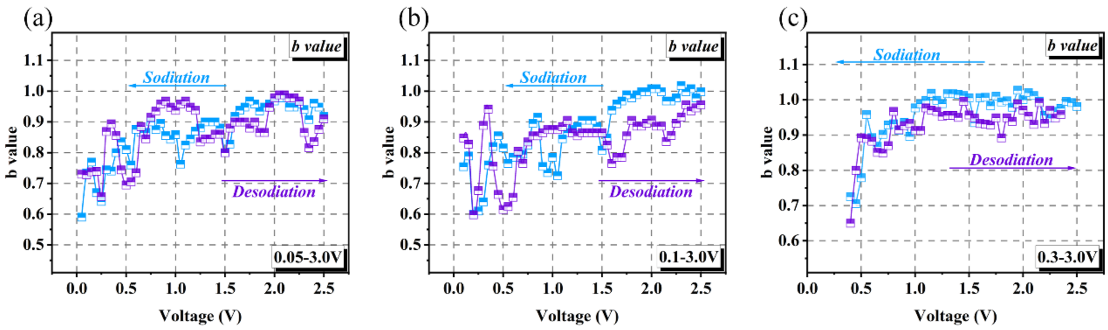

Fig. S2 The variation of b values upon discharging and charging of $MoS_2/Ti_3C_2T_x$ with the discharge cut-off voltage of 0.05 V (a), 0.1 V (b), and 0.3 V (c).

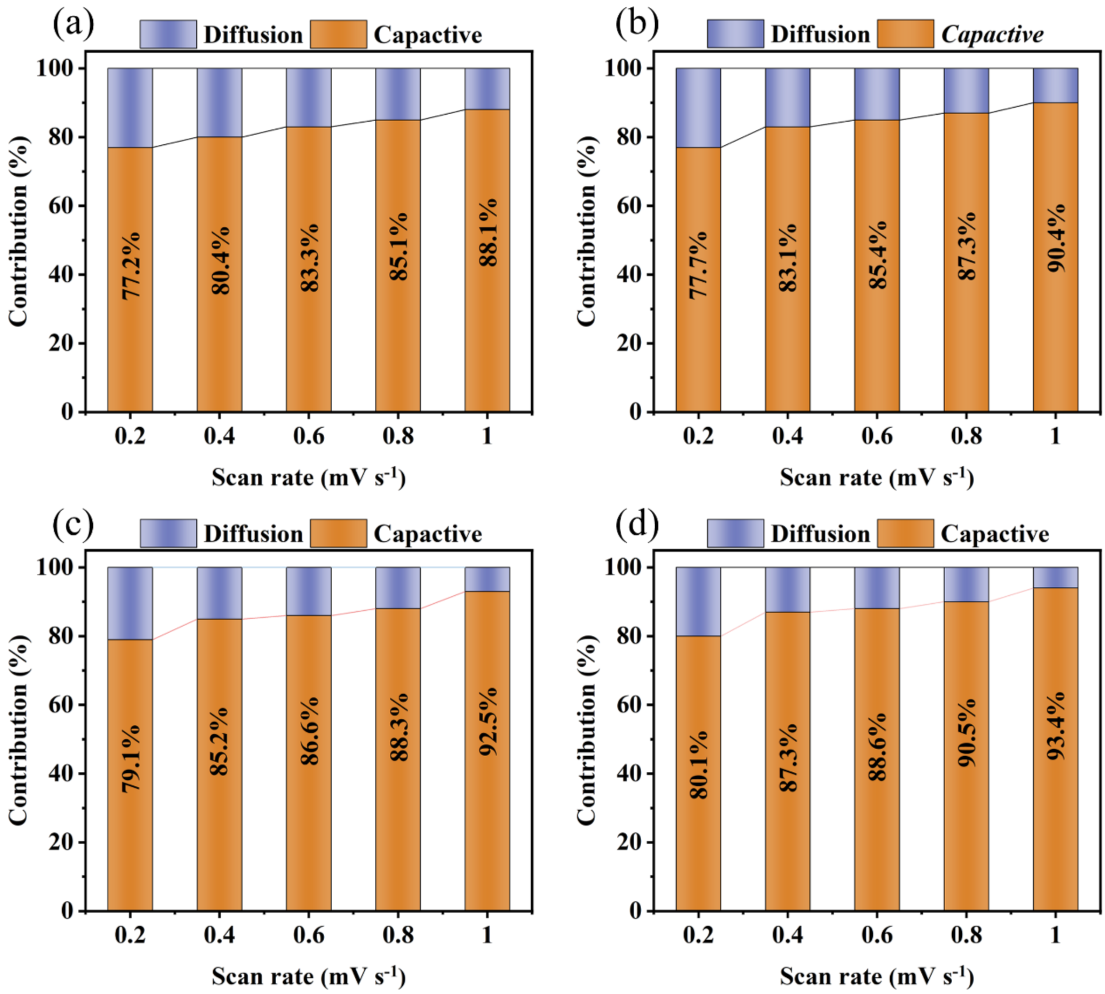

Fig. S3 Charge contributions from diffusion and pseudocapacitive effect of $MoS_2/Ti_3C_2T_x$ with the discharge cut-off voltage of 0.05 V (a), 0.1V (b), 0.2V (c), and 0.3 V (d).

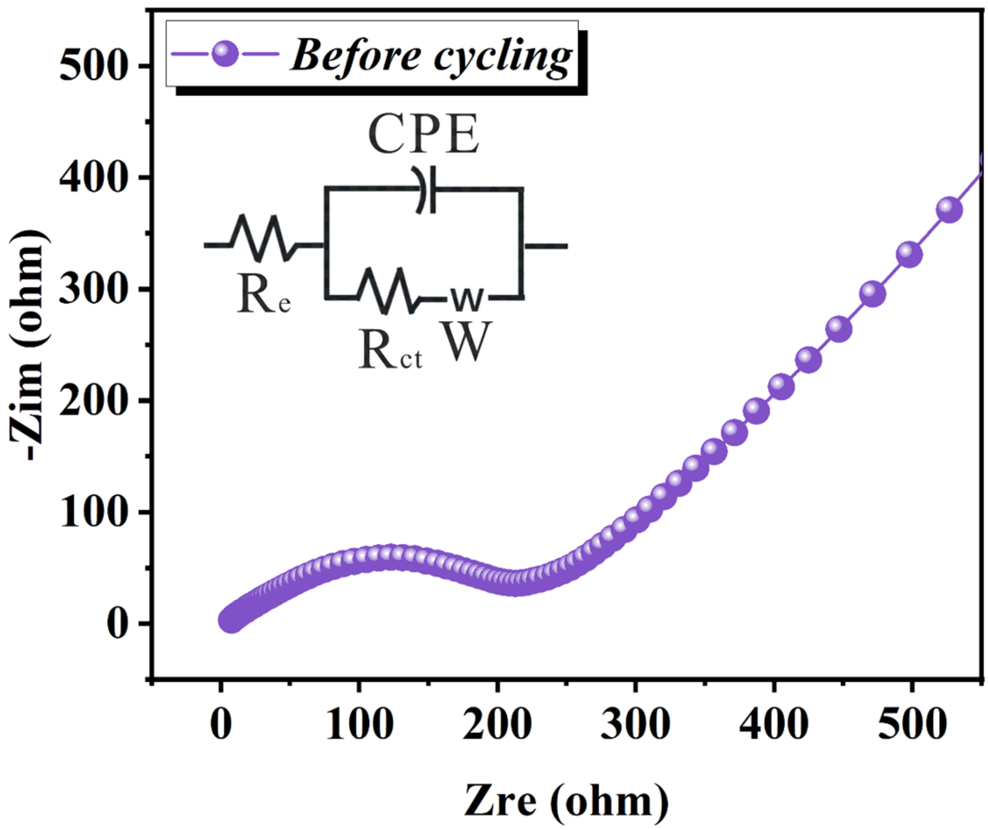

Fig. S4 Nyquist plot of the $MoS_2/Ti_3C_2T_x$ electrode before cycling (insert is the corresponding equivalent circuit model).

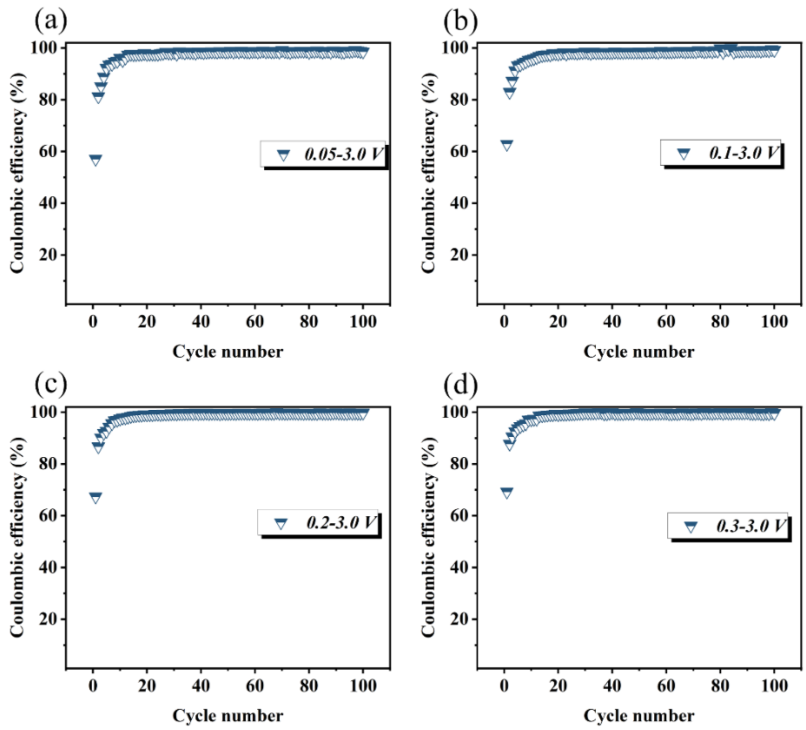

Fig. S5 The Coulombic efficiencies of $MoS_2/Ti_3C_2T_x$ with the discharge cut-off voltage of 0.05 V (a), 0.1V (b), 0.2 V (c), and 0.3 V (d).

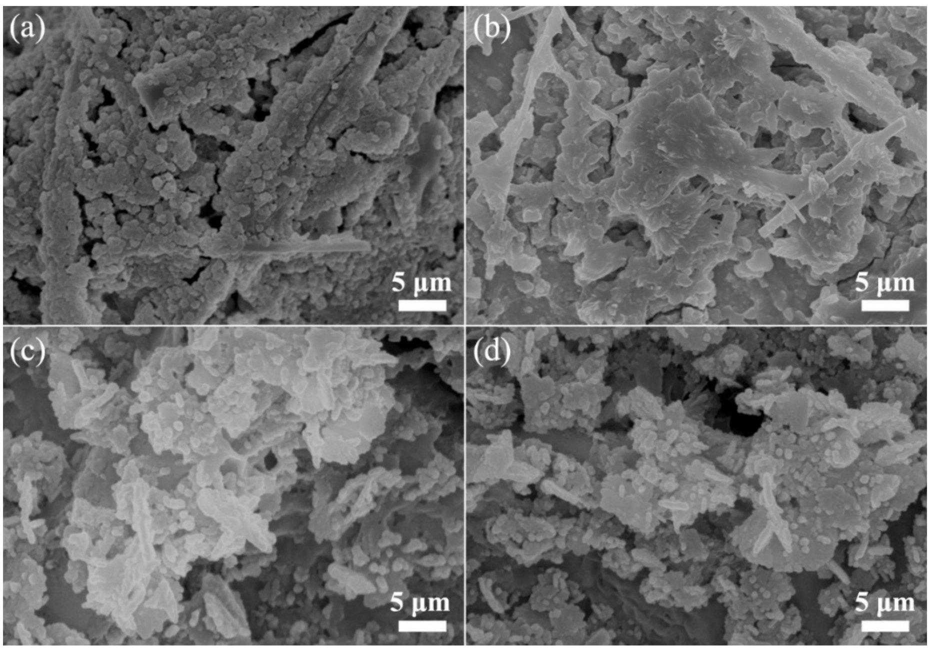

Fig. S6. FESEM images of $MoS_2/Ti_3C_2T_x$ electrode after 10 cycles at 0.5 A g^{-1} with the discharge cut-off voltages of 0.05 (a), 0.1 (b), 0.2 (c) and 0.3 V (d).

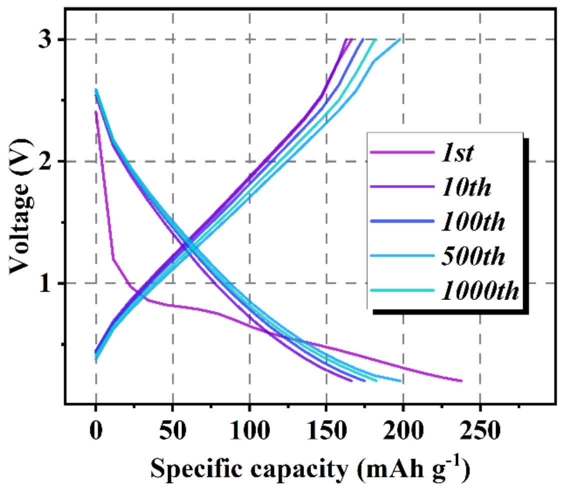

Fig. S7 Rate profiles of $MoS_2/Ti_3C_2T_x$ with the discharge cut-off voltage of 0.2 V.

Table S1 The comparison of electrochemical performance of the as-prepared $MoS_2/Ti_3C_2T_x$ with optimized voltage window and other related studies focused on the modification of voltage window.

Samples	Voltage range (V)	Cycling performance	Rate capability	Ref.
WS_2 nano-plates (ester-based electrolyte)	0.01-2.0	About 241.6 mAh g^{-1} after 50 cycles at 0.1 A g^{-1}	About 351.8 mAh g^{-1} at 0.05 A g^{-1} About 301.7 mAh g^{-1} at 0.1 A g^{-1} About 296.2 mAh g^{-1} at 0.2 A g^{-1} About 256.2 mAh g^{-1} at 0.5 A g^{-1} About 206.6 mAh g^{-1} at 1.0 A g^{-1} About 181.5 mAh g^{-1} at 2.0 A g^{-1}	1
MoS_2@reduced graphene oxide (ester-based electrolyte)	0.4-3	137.4 mAh g^{-1} after 1000 cycles at 0.5 A g^{-1}	/	2

FG-MoS_2 (ester-based electrolyte)	0.4-3	295.0 mAh g^{-1} after 300 cycles at 0.2 A g^{-1}	About 208.2 mAh g^{-1} at 0.2 A g^{-1} About 200.3 mAh g^{-1} at 1.0 A g^{-1} About 199.3 mAh g^{-1} at 3.0 A g^{-1} About 188.6 mAh g^{-1}at 6.0 A g^{-1} About 179.1 mAh g^{-1} at 8.0 A g^{-1} About 175.1 mAh g^{-1} at 10.0 A g^{-1}	3
MoS_2 decorated on $Ti_3C_2T_x$ (ester-based electrolyte)	0.01-3	250.9 mAh g^{-1} after 100 cycles at 0.1 A g^{-1}	392.6 mAh g^{-1} at 0.05 A g^{-1} 285.4 mAh g^{-1}at 0.1 A g^{-1} 245.6 mAh g-1 at 0.2 A g^{-1} 207.2 mAh g^{-1} at 0.5 A g^{-1} 162.7 mAh g^{-1} at 1.0 A g^{-1}	4
$MoS_2/Ti_3C_2T_x$ (ester-based electrolyte)	0.2-3	258.2 mAh g^{-1} after 100 cycles at 0.1 A g^{-1}	256.3 mAh g^{-1} at 0.1 A g^{-1} 206.2 mAh g^{-1} at 0.5 A g^{-1} 173.3 mAh g^{-1} at 1.0 A g^{-1} 159.4 mAh g^{-1}at 3.0 A g^{-1} 149.0 mAh g^{-1}at 5.0 A g^{-1}	This work

Reference

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