Electronic Supplementary Information
Strain Buffering Effect of Quasi-Amorphous Disordered Microstructure Enabling Long-Term Fast Sodium Storage Performance

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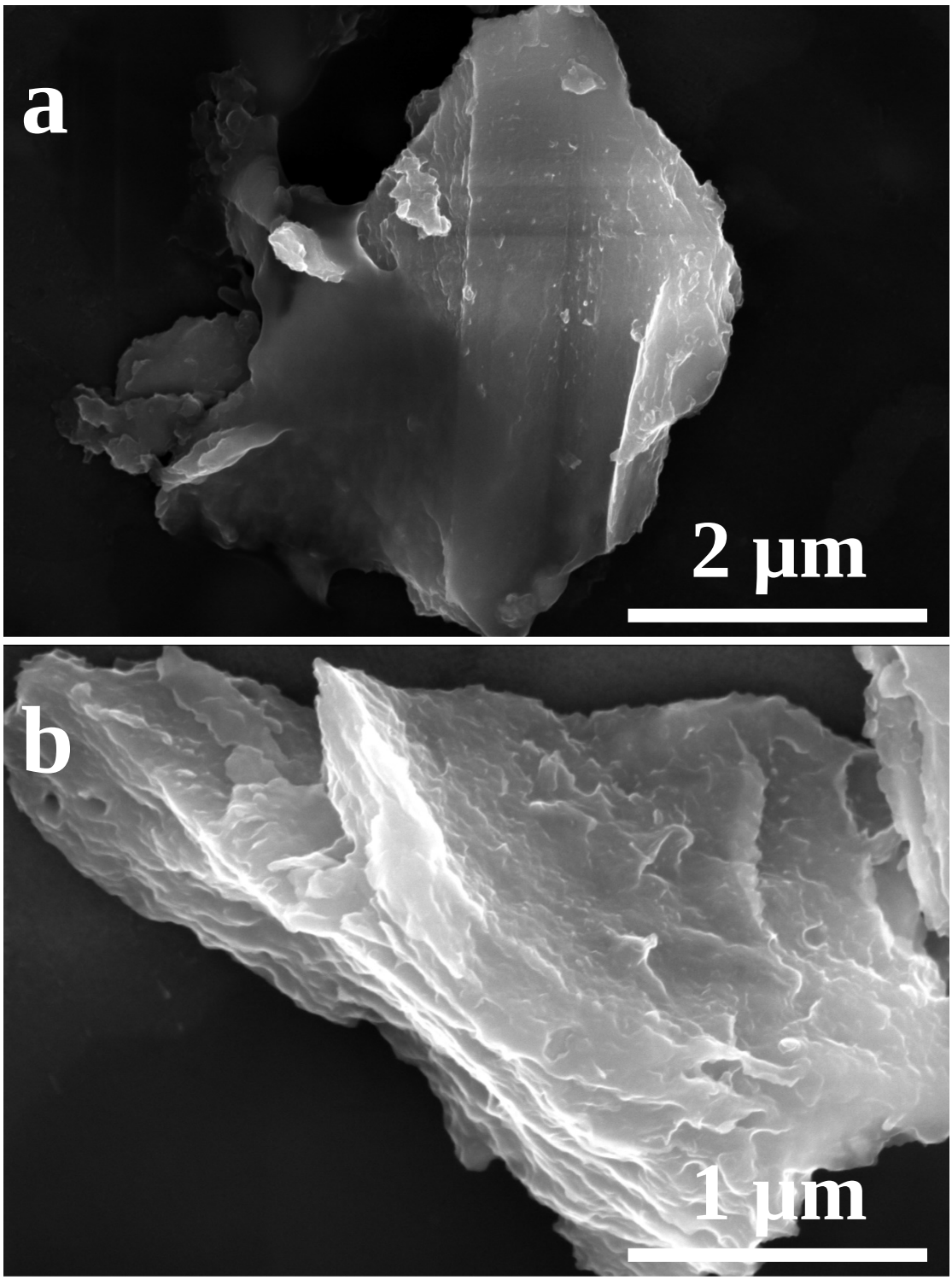

Fig. S1 (a-b) SEM secondary electronic images of the FLD-MoS_2/NC.

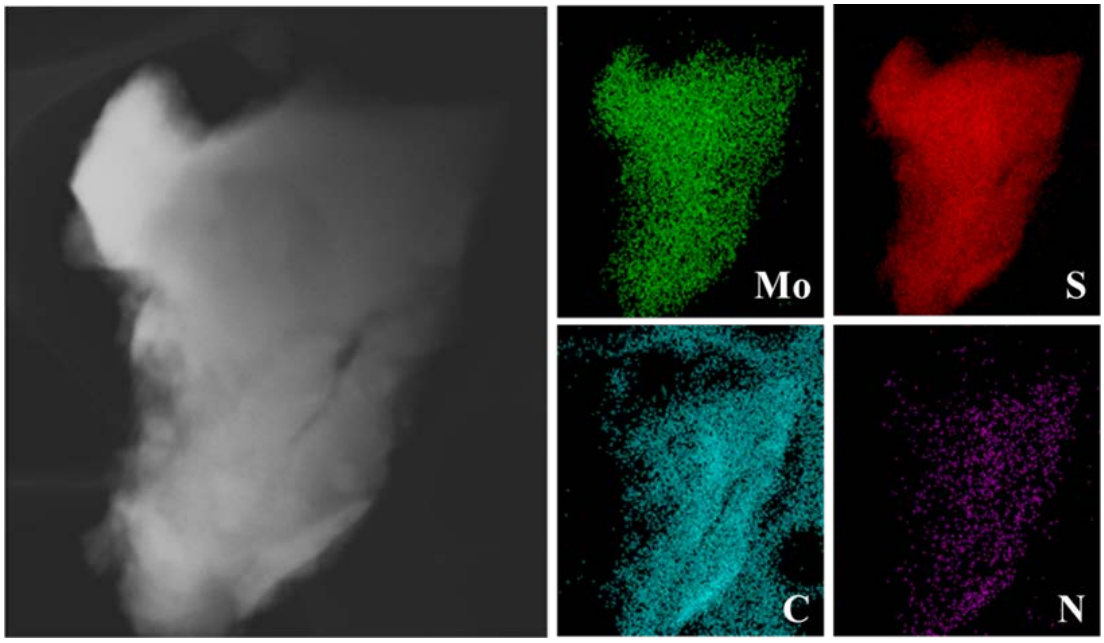

Fig. S2 Electronic image and the corresponding elemental mapping analysis of the FLD-MoS_2/NC.

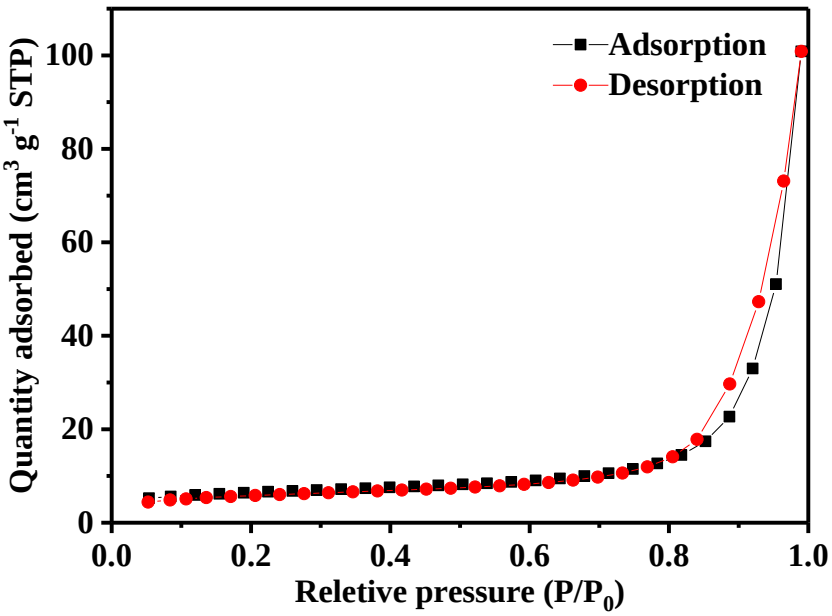

Fig. S3 The N_2 adsorption-desorption isotherm of the FLD-MoS_2/NC.

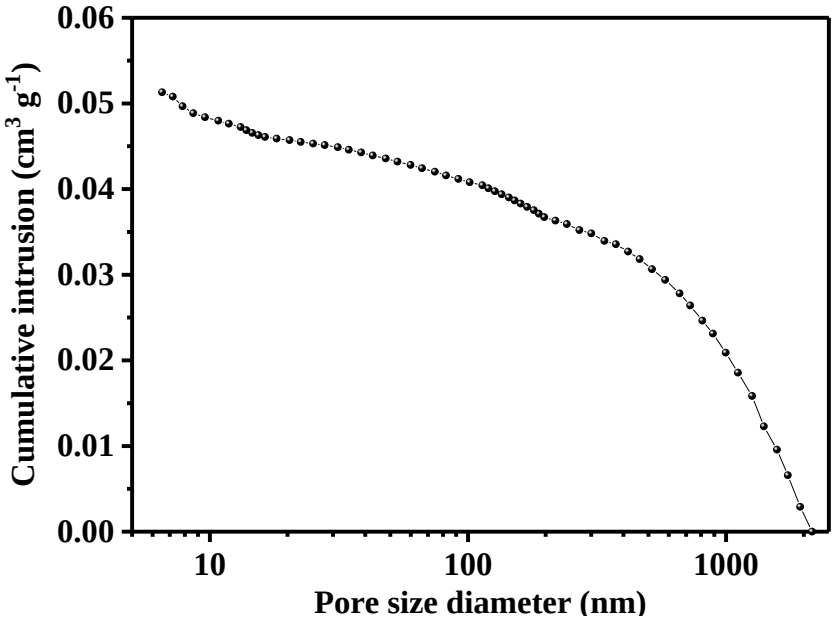

Fig. S4 The curve of cumulative intrusion vs. pore size of the FLD-MoS_2/NC.

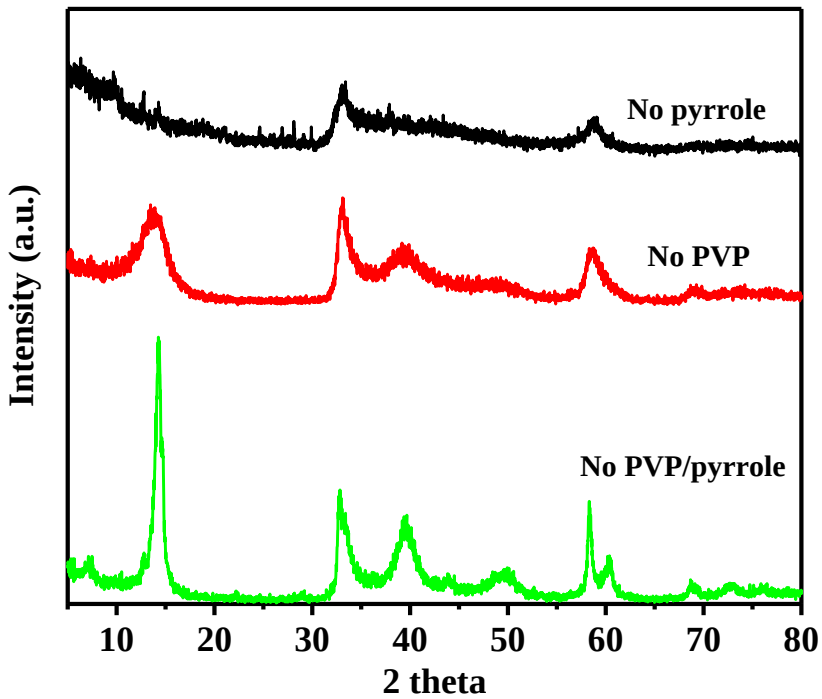

Fig. S5 XRD patterns of the samples without adding pyrrole monomer or PVP or both.

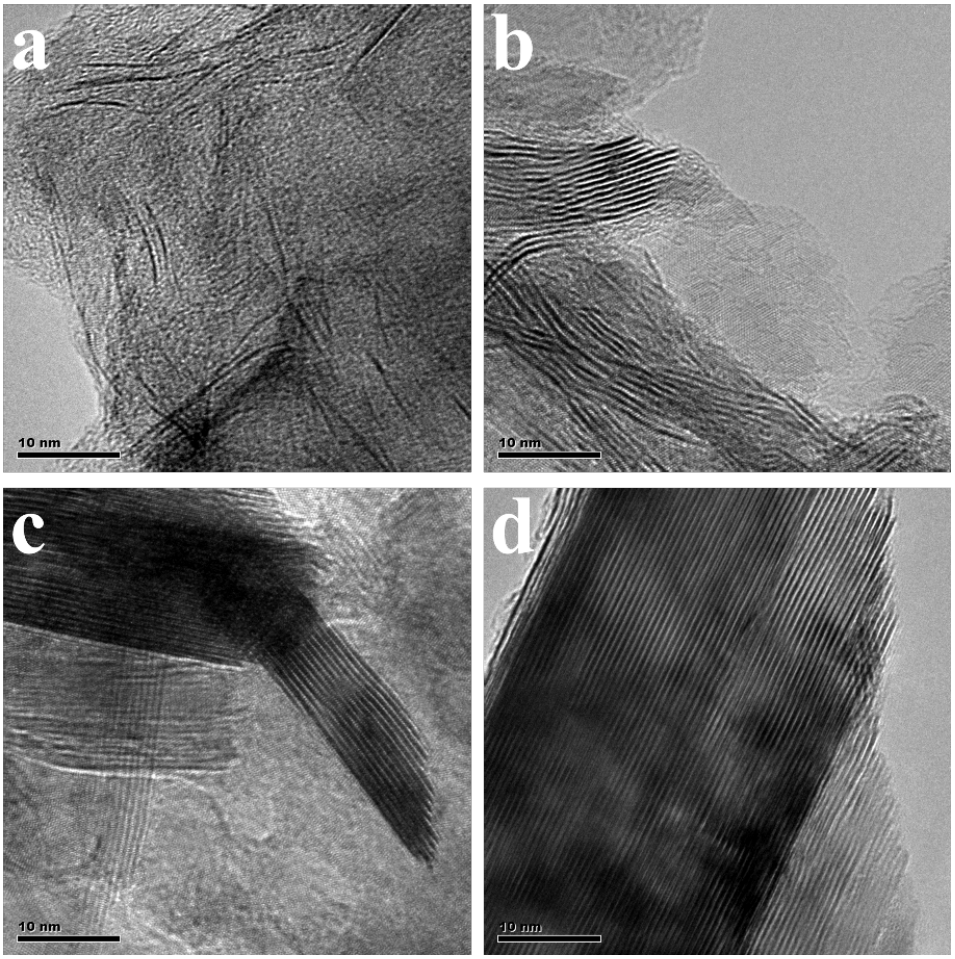

Fig. S6 HR-TEM images of the comparison among (a) MoS_2-no pyrrole, (b) MoS_2-no PVP, (c) MoS_2-no PVP/pyrrole and (d) commercial MoS_2.

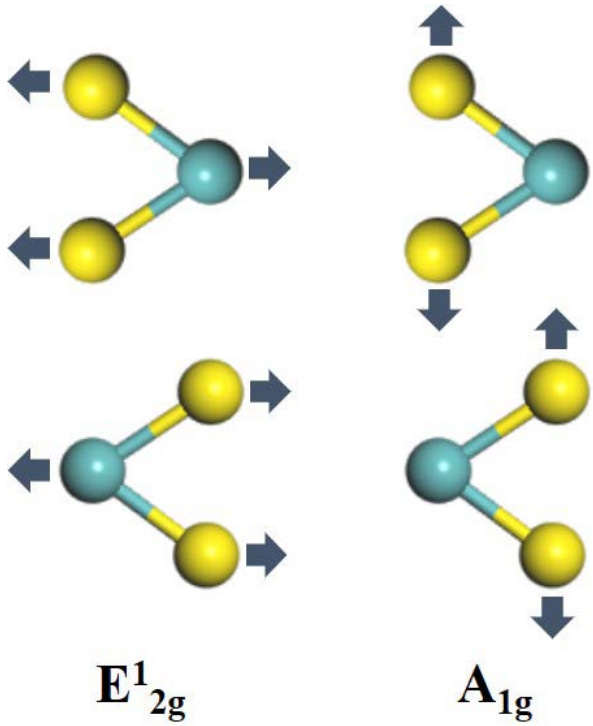

Fig. S7 Illustration of E^1_{2g} and A_{1g} vibration modes of MoS_2.

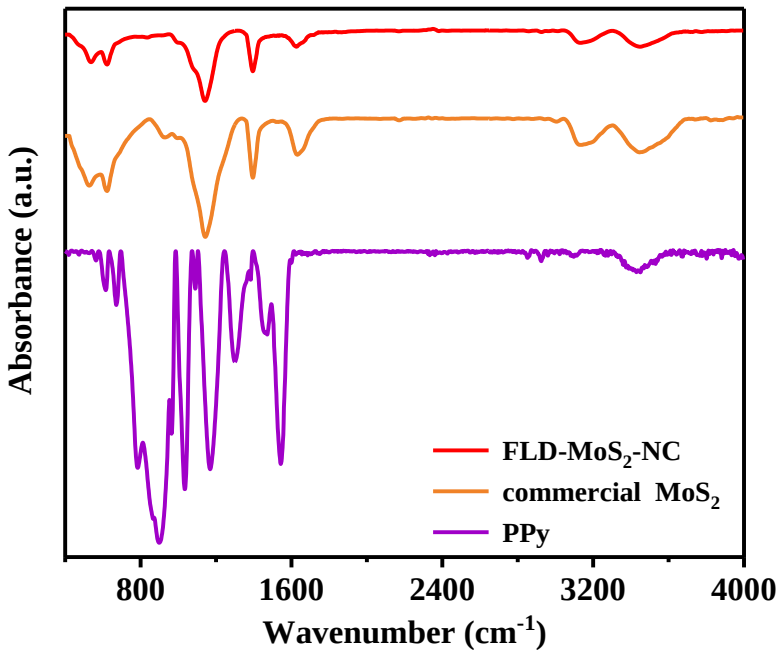

Fig. S8 FTIR analysis of the FLD-MoS_2/NC, commercial MoS_2 and PPy.

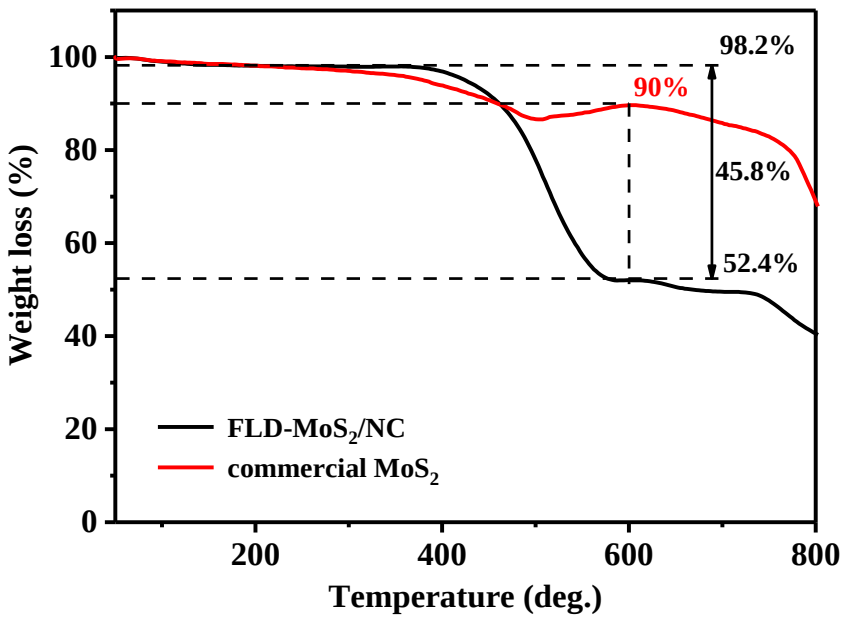

Fig. S9 TG analysis of FLD-MoS_2/NC and commercial MoS_2.

From 300 ℃ to 600 ℃, an obvious weight loss of 45.8% can be observed for the FLD-MoS_2/NC. For commercial MoS_2 during the same temperature range, the weight loss is 8.2%. Then the weight ratio of the N-doped carbon in the FLD-MoS_2/NC is calculated to be 40.96%. The calculation is presented as follows. Set the weight ratios of MoS_2 and N-doped carbon as ω_1 and ω_2, respectively. Then we have the following equations.

$$\omega_1 + \omega_2 = 100\%$$

$$\omega_1 \times 8.2\% + \omega_2 = 45.8\%$$

Finally, we can calculate that the weight ratio of N-doped carbon (ω_2) is 40.96%.

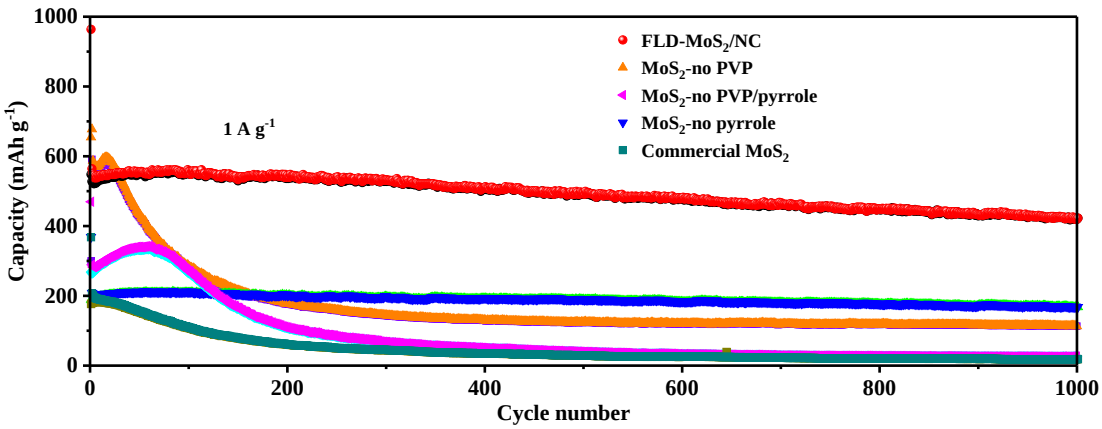

Fig. S10 Cycle performance comparison among FLD-MoS_2/NC, MoS_2-no PVP, MoS_2-no PVP/pyrrole, MoS_2-no pyrrole and commercial MoS_2. The current density is 1 A g^{-1}.

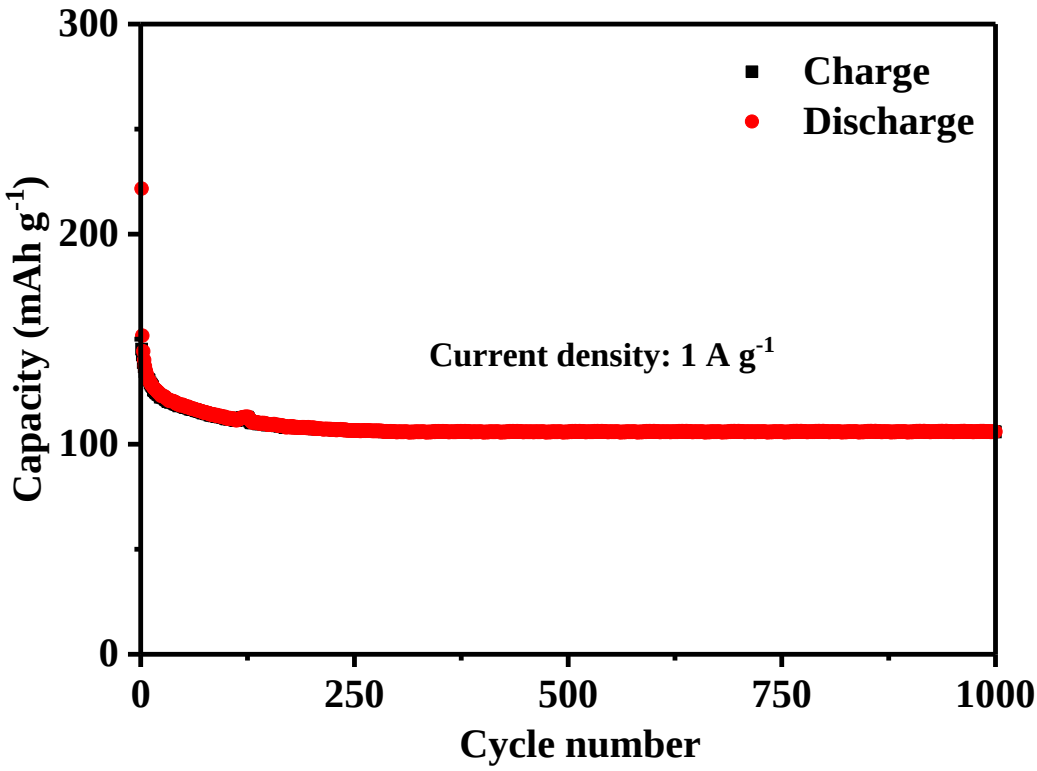

Fig.S11 The sodium storage performance of the carbon matrix at the current density of 1 A g^{-1}.

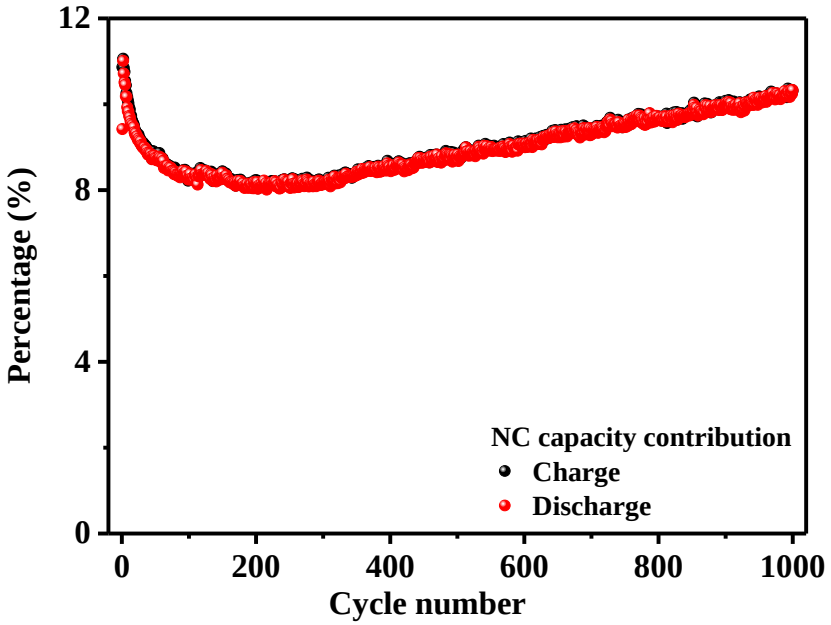

Fig. S12 Percentage of NC contribution to the capacity of FLD-MoS_2/NC at 1 A g^{-1}.

For the purpose of consistency, the electrode of N-doped carbon matrix was also prepared in the weight ratio of 70 wt.% active material, 20 wt.% Super-P conductive carbon black and 10 wt.% PVDF binder. The capacity was normalized to the weight of active material. The calculation of NC contribution is presented as follows. Set the experimental specific capacities of FLD-MoS_2/NC and NC as C and C_N, respectively. The masses of FLD-MoS_2/NC and NC are set as m and m_N, respectively. The weight ratio of NC is ω_N. Then the NC contribution to the capacity (W) should be expressed as the equation below.

$$W = \frac{C_N m_N}{Cm} = \frac{C_N}{C}\omega_N$$

The values of C, C_N and ω_N can be obtained from Fig. 4c, Fig. S11 and Fig. S9, respectively. Then the NC contribution to the capacity at 1 A g^{-1} is presented below. It can be seen that during the 1000 cycles at 1 A g^{-1}, the NC contribution to the whole capacity is in the range from 8% to 11%.

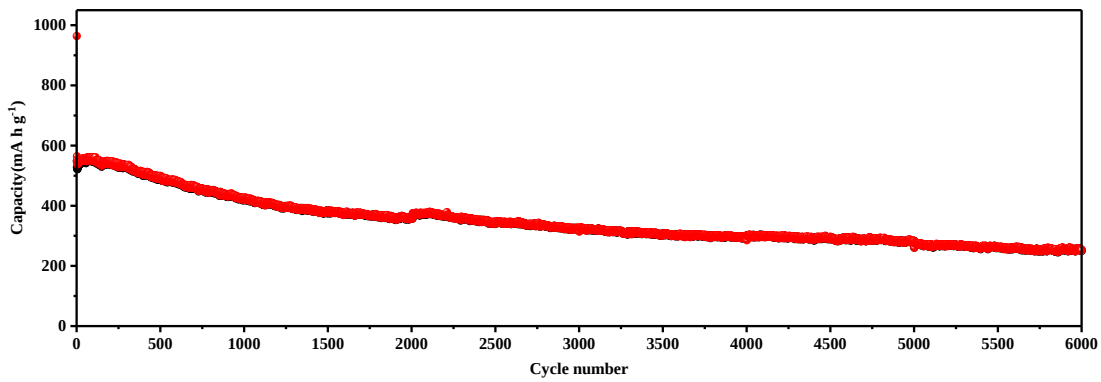

Fig. S13 Prolonged cycle performance of FLD-MoS_2/NC at 1A g^{-1}.

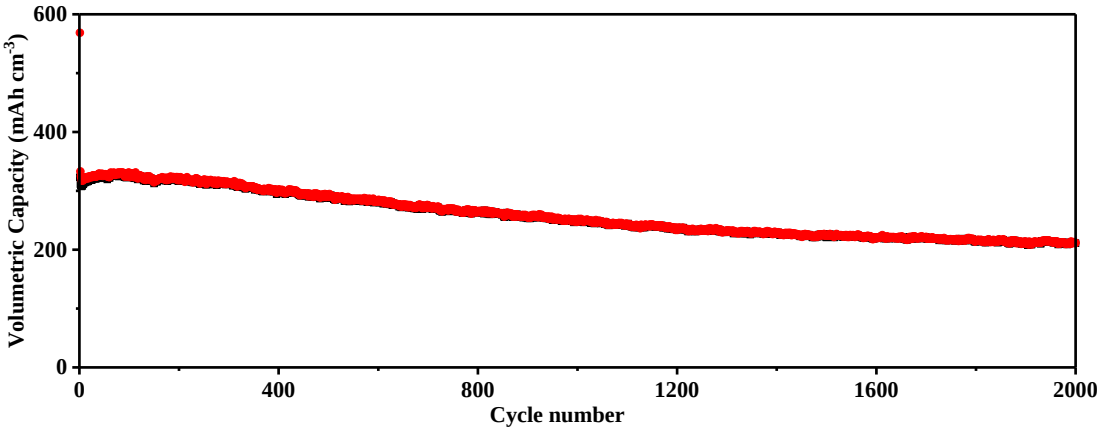

Fig. S14 Cycle performance based on volumetric capacity of the FLD-MoS_2/NC.

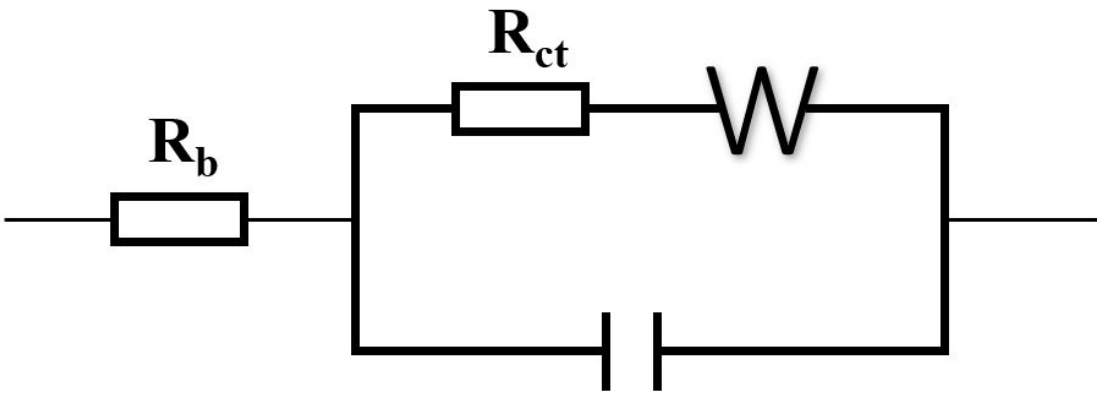

Fig. S15 The equivalent circuit for EIS analysis.

	R_b	R_{ct}
FLD-MoS_2/NC	9.89 Ω	152 Ω
MoS_2 without NC	12.3 Ω	691 Ω

Table S1 EIS analysis of the FLD-MoS_2/NC and MoS_2 without NC after cycling.

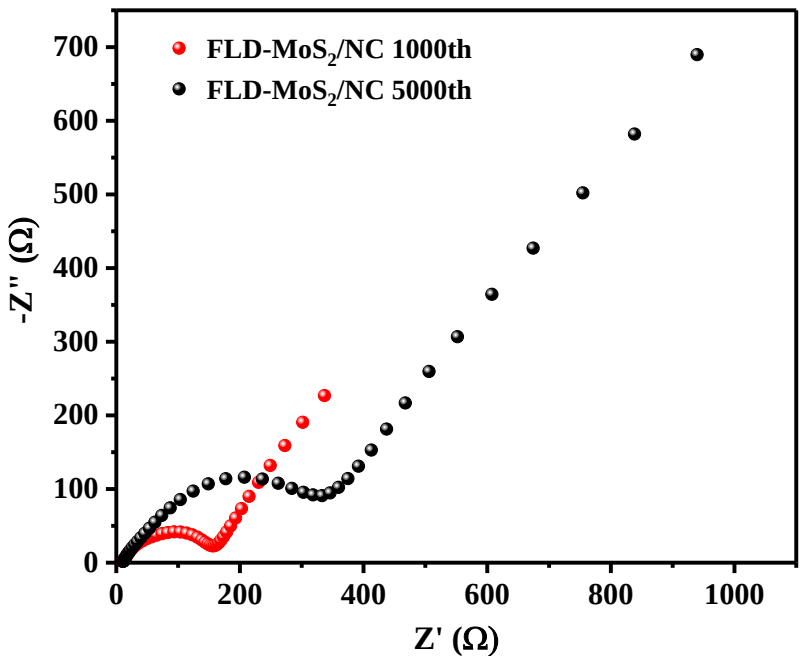

Fig. S16 Nyquist plot of the FLD-MoS_2/NC after 1000 and 5000 cycles at 1 A g^{-1}.

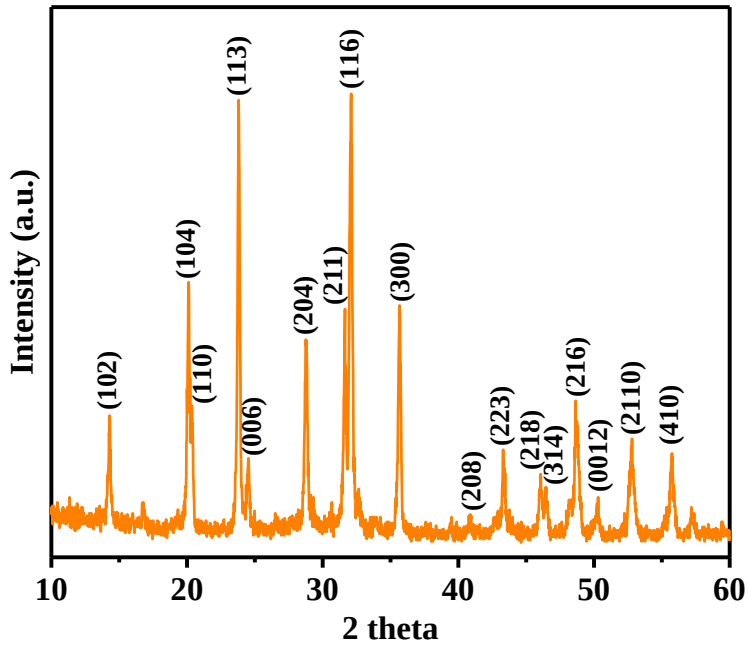

Fig. S17 XRD pattern of the NVP/C.

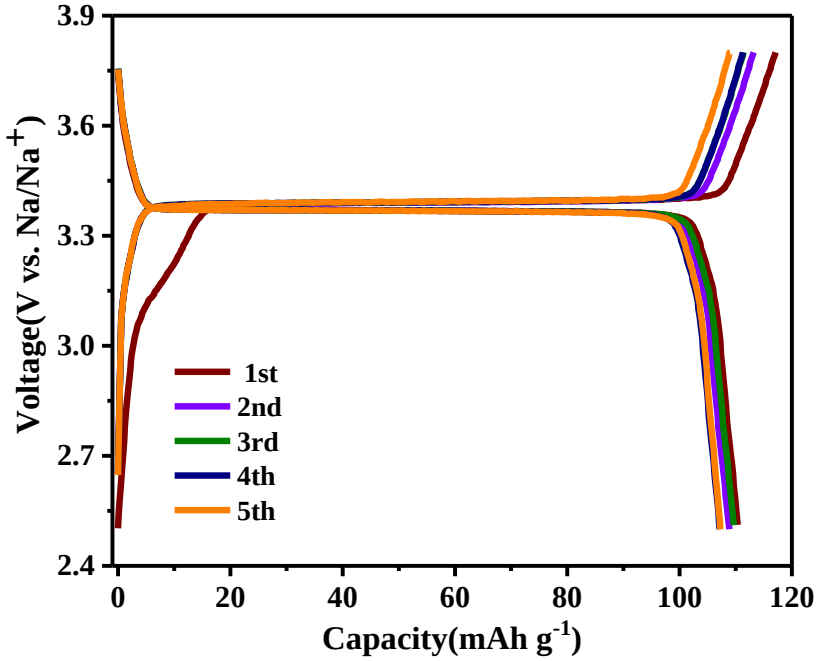

Fig. S18 Charge-discharge curves of the NVP/C at 0.1 C for the initial 5 cycles in Na half-cell.

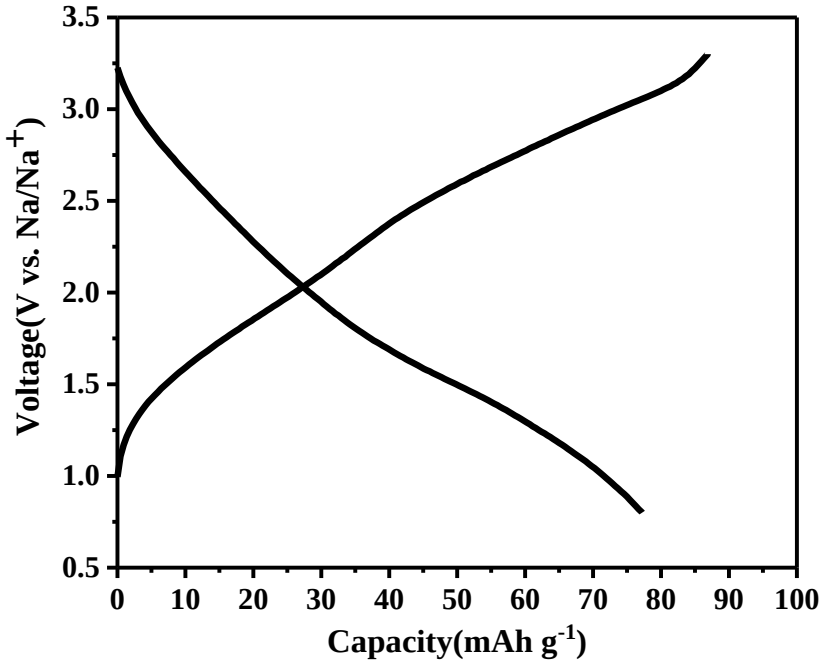

Fig. S19 Initial charge-discharge curves of Na-ion full cell at 0.1 C.

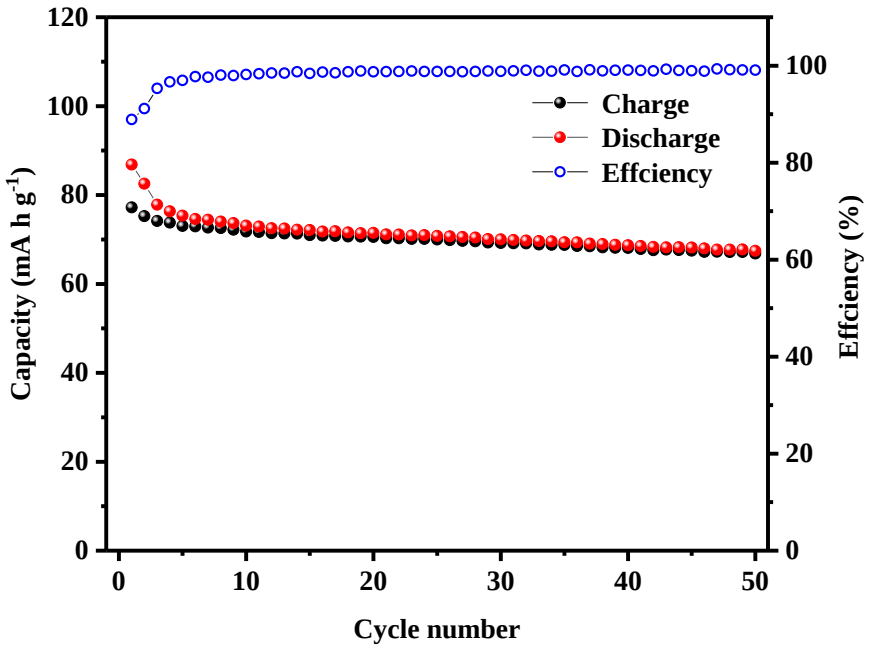

Fig. S20 Cycle performance of Na-ion full cell at 0.1 C.

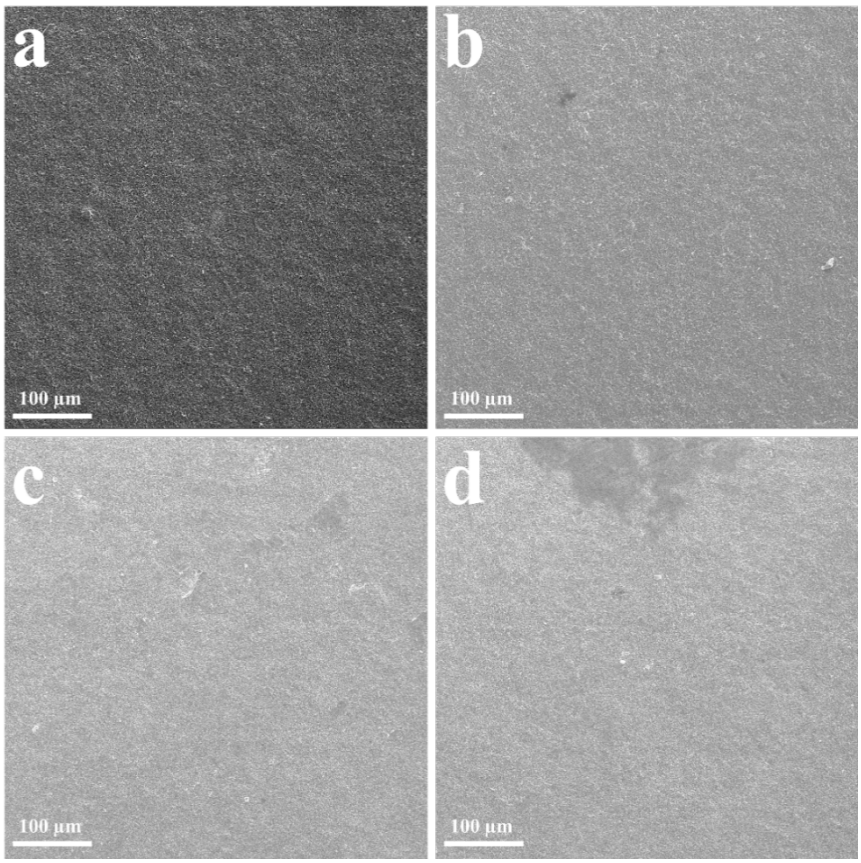

Fig. S21 SEM images of electrodes before cycling: (a) FLD-MoS_2/NC, (b) MoS_2-no pyrrole (c) MoS_2-no PVP and (d) MoS_2-no PVP/pyrrole.