Supporting Information for

Interlayer engineering of MoS_2 nanosheets for high-rate potassium-ion storage

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$$i = av^b \quad (1)$$

Where i is the peak current, v is the scan rate, and a and b are the parameters. The value of b is calculated from the $\log(i) - \log(v)$ curve to determine the electrochemical behavior. $b = 1$ represents the pseudocapacitance control process, $b = 0.5$ represents the diffusion control process.

$$i(v) = k_1 v + k_2 v^{1/2} \quad (2)$$

Where i is the peak current and v is the scan rate. $k_1 v$ and $k_2 v^{1/2}$ represent the capacitive control process and diffusion control process. To obtain the values of the parameters k_1 and k_2, we draw $i/v^{1/2}$ and $v^{1/2}$, where k_1 and k_2 can be determined by the slope on the straight line and the y-axis intercept point.

$$D = \frac{4}{\pi\tau}\left(\frac{m_B V_M}{M_B S}\right)^2\left(\frac{\Delta E_S}{\Delta E_t}\right)^2 \quad (3)$$

Where τ is the relaxation time; m_B is the mass of the electrode active material; V_M is the molar volume of the electrode material; M_B the molar mass of the electrode active material; S is the area of the electrode; ΔE_S is the voltage change due to the pulse; ΔE_t is the constant current charge (discharge) voltage variation of the electricity.

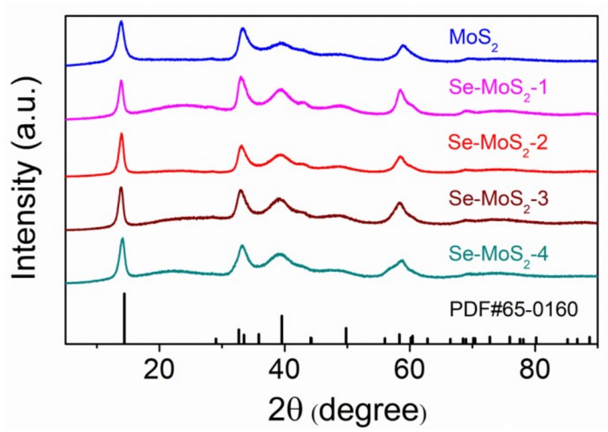

Fig. S1 XRD patterns for all the samples.

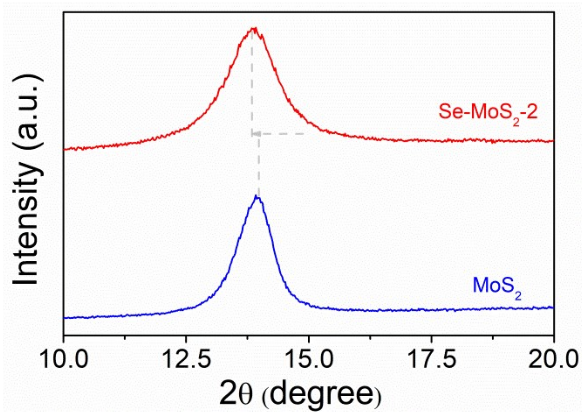

Fig. S2 XRD patterns for MoS_2 and Se-MoS_2-2.

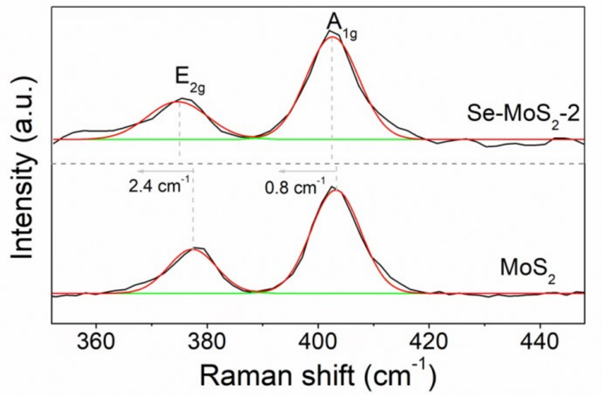

Fig. S3 Raman spectrum for MoS_2 and Se-MoS_2-2.

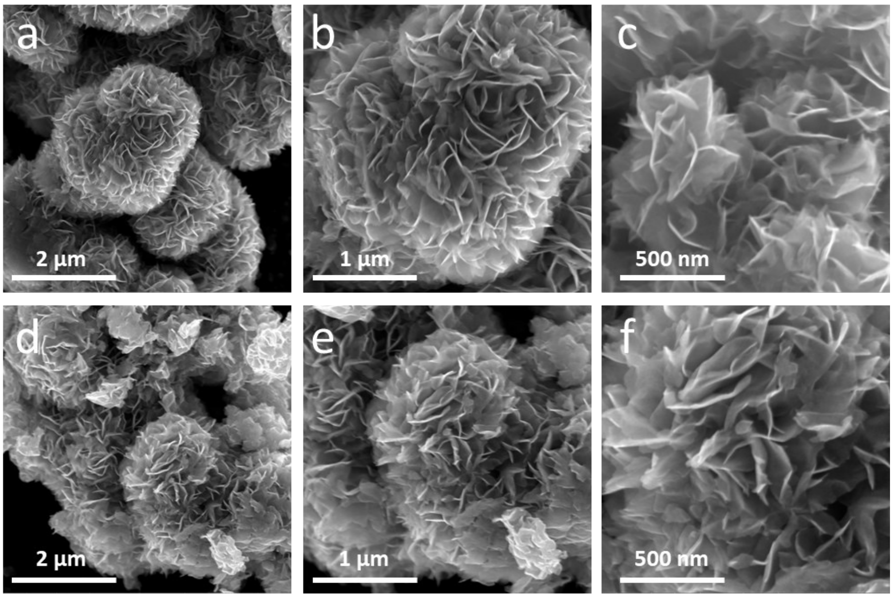

Fig. S4 (a-c) SEM for MoS_2; (d-e) SEM for Se-MoS_2-2.

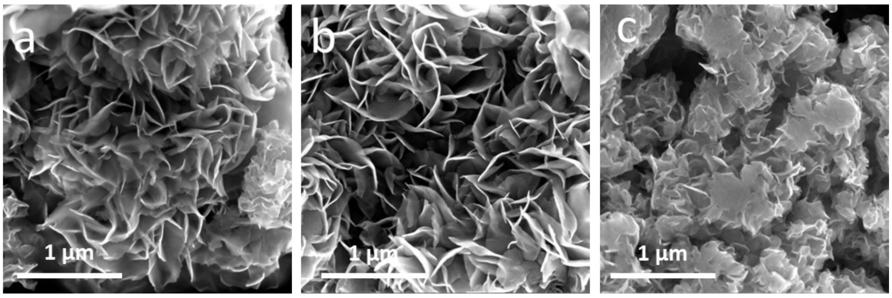

Fig. S5 (a) SEM for Se-MoS_2-1; (b) SEM for Se-MoS_2-3; (c) SEM for Se-MoS_2-4.

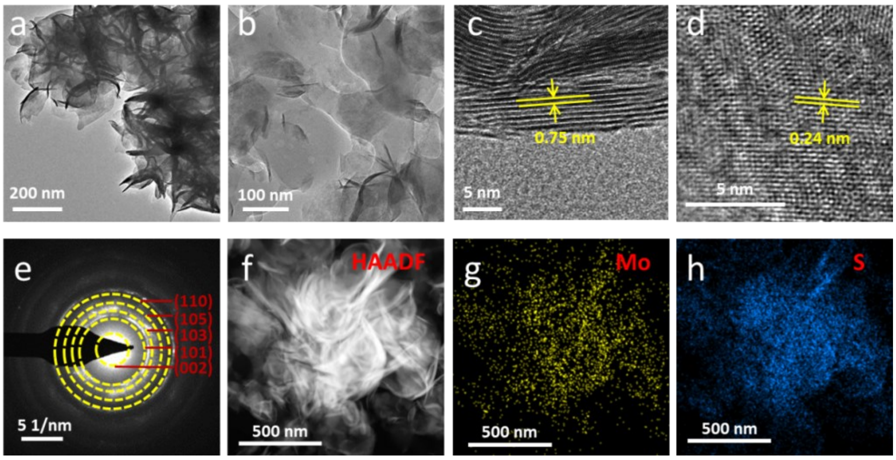

Fig. S6 (a,b) TEM images; (c,d) HRTEM images; (e) SAED pattern; (f-h) HAAADF-STEM and elemental mapping images for MoS_2.

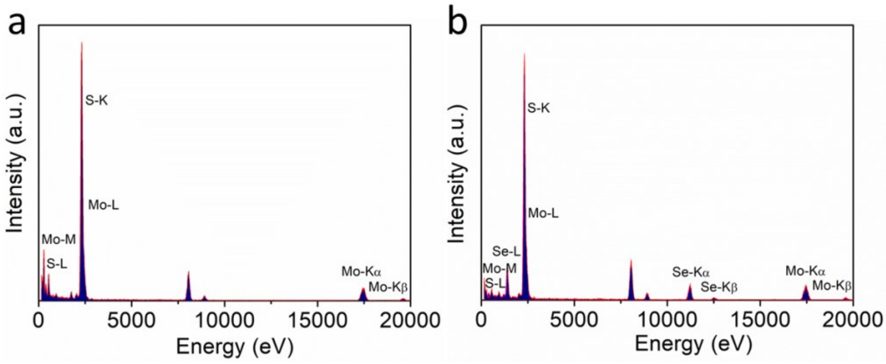

Fig. S7 (a) Energy spectrum for MoS_2; (b) Energy spectrum for Se-MoS_2-2.

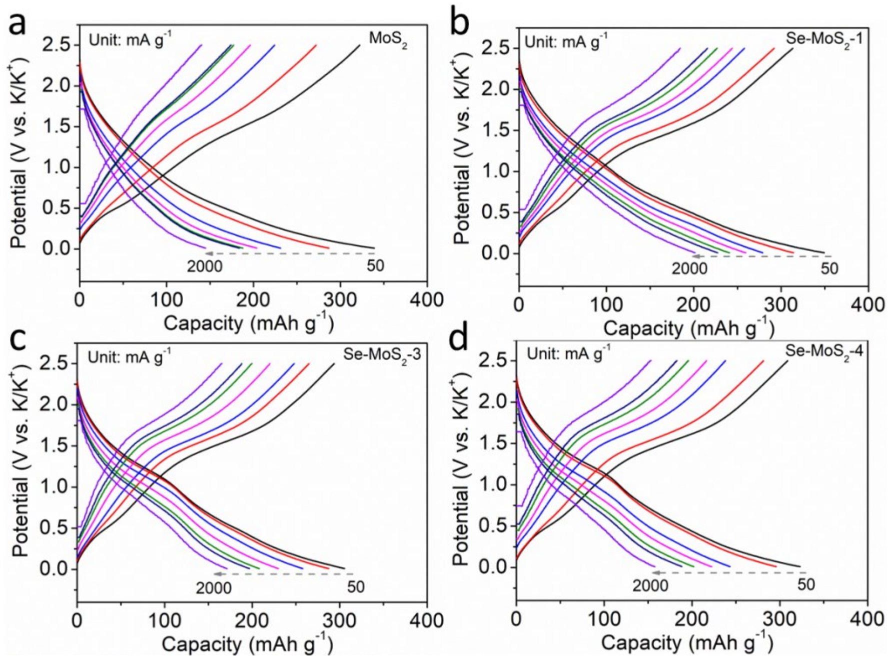

Fig. S8 Charge/discharge curves at 50 to 2000 mA g^{-1} (a) for MoS_2; (b) for Se-MoS_2-1; (c) for Se-MoS_2-3; (d) for Se-MoS_2-4.

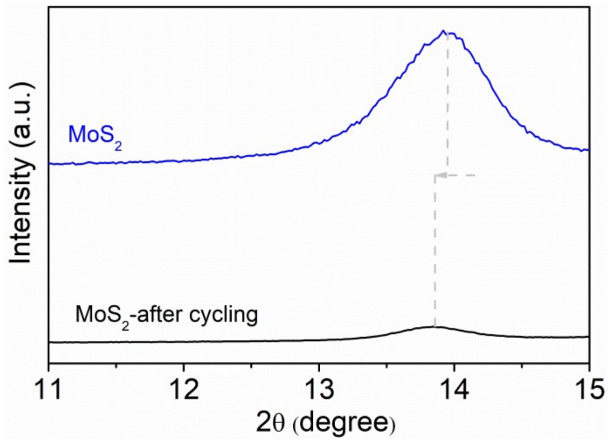

Fig. S9 XRD patterns of MoS_2 and MoS_2 after cycling.

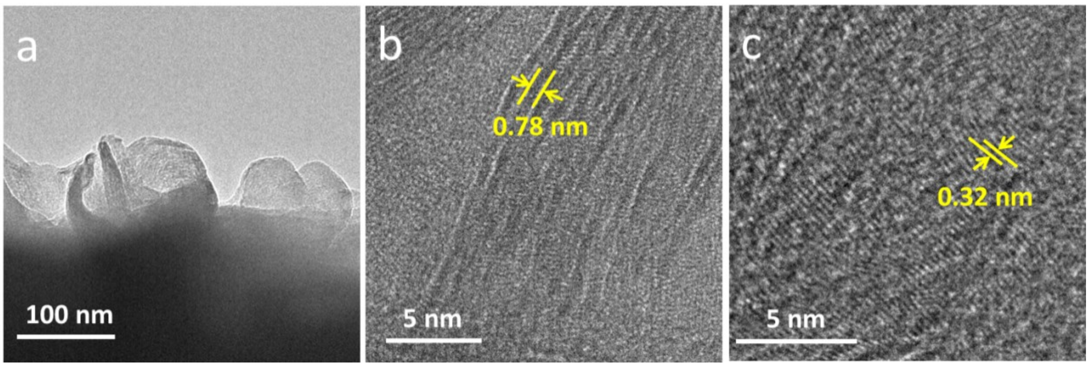

Fig. S10 HRTEM images for MoS_2 after cycling.

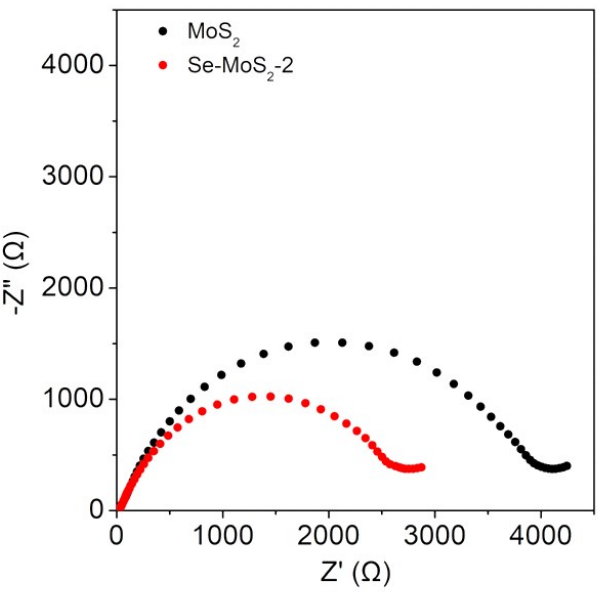

Fig. S11 The Nyquist plots for MoS_2 and Se-MoS_2-2 after 1000 cycles.

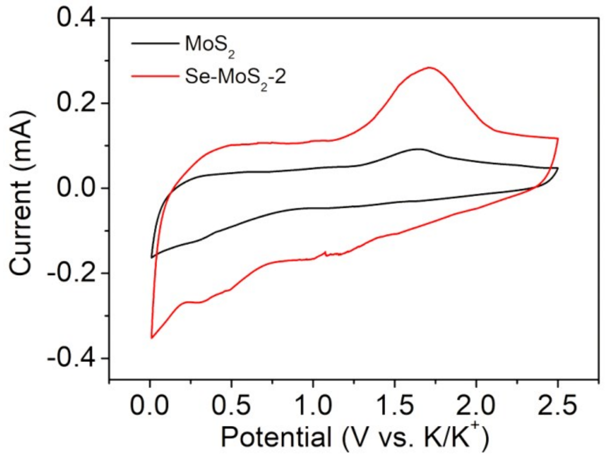

Fig. S12 CV curves of MoS_2 and Se-MoS_2-2 at 0.2 mV s^{-1}.

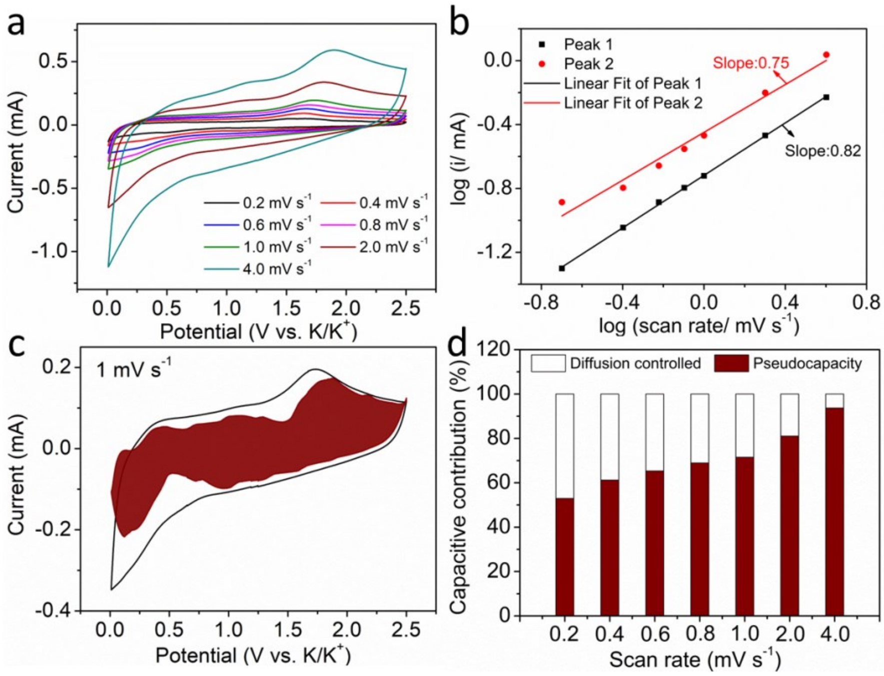

Fig. S13 (a) CV curves of MoS_2 at scan rates from 0.2 to 4 mV s^{-1}; (b) the relationship peak current and scan rates; (c) the total and capacitive current responses at a 1 mV s^{-1} are the area enclosed by black lines and the shaded region;(d) The percentages of capacitive contributions at different scan rates.

Table S1 Comparison of the potassium storage performance of Se-MoS_2-2 in this work with the rate performance of previously reported materials

Anode materials	**Current density: mA g^{-1}**	**Capacity: mAh g^{-1}**	**Reference**
Se-MoS_2	From 50 to 2000	From 642 to 212	This work
Fe_9S_{10}@MoS_2@C	From 500 to 2000	Form 288 to 205	1
MoS_2/N-doped-C	From 100 to 2000	From 258 to 131	2
$MoSe_2$/N-C	From 100 to 2000	From 300 to 178	3
MoO_2/rGO	From 50 to 500	From 281.8 to 176.4	4
MoS_2@rGO	From 100 to 2000	From 364.8 to 196.8	5
MoS_2@SnO_2@C	From 50 to 2000	From 595 to 168	6
EF-Ta_2NiSe_5	From 50 to 2000	From 308 to 62	7

Reference

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