Electronic Supplementary Material (ESI) for Dalton Transactions.
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Supporting Information

Characterization

Using X-ray diffraction (XRD) to ascertain the crystal phase of composition at 10° to 80° by Bruker D8 diffractometer. The surface morphology and internal crystal structure of test material samples were observed by SEM (Hitachi 8100) and TEM (FEI F20 S-TWIN). The thermogravimetric analysis (TGA) was conducted to measure the compound by TA-SDT Q600 analyzer. The heating rate in the atmosphere was 10 °C min^{-1}. The attribute of chemical bonds was determined by Raman spectroscopy (DXR2xi) of a 532 nm laser. The surface property of the composition was research by X-ray photoelectron spectroscopy (XPS). Galvanostatic charge/discharge tests and the galvanostatic intermittent titration technique (GITT) of the electrode materials were tested on Land CT 2001A tester between 0.01 to 3 V. The cyclic voltammetry (CV) tests were conducted by an Ivium-n-Stat electrochemical workstation at diverse scan rates (vs. Na/Na^+ or K/K^+).

Electrochemical measurements

For SIBs, the anode electrode was formed by blending the active component, super P and carboxymethyl cellulose (CMC) in a proportion of 8: 1: 1 in deionized water. Each active material loaded in the anode electrodes is closed to 1.5-2.5 mg cm^{-2} for SIBs tests system. The solution was fixed to copper foil and dried at 80 °C overnight under vacuum. In the half sodium-ion batteries, 1 M $NaClO_4$ in 1:1 (weight ratio) EC/DMC with 5% fluoroethylene carbonate (FEC) additives and whatman glass fiber were conducted as electrolyte and separator, respectively. In the half-cells, sodium metal was served as the counter electrode. While the capacity ratio of 1T-MoS_2-Sb anode and NVP cathode was optimized to 1: 1.2 in the sodium full-cells. The 1T-MoS_2-Sb anode was presodiated for three cycles before assembling full cells.

As for PIBs half-battery, the anode was fabricated by admixing the active materials (1T-MoS_2-Sb, 80 wt.%) with super P (10 wt.%) and CMC (10 wt.%) in deionized water. Every active material loaded in active materials in the anode electrodes is closed to 1.0-2.0 mg cm^{-2} for PIBs tests. In addition, 3.0 M potassium bis(fluorosulfonyl)imide (KFSI) in DME (100% *Vol*%) was employed as electrolyte. The counter electrode was made up of sheet potassium metal. Last but not least, all the assembly work was carried out in a glove box filled with high pure argon.

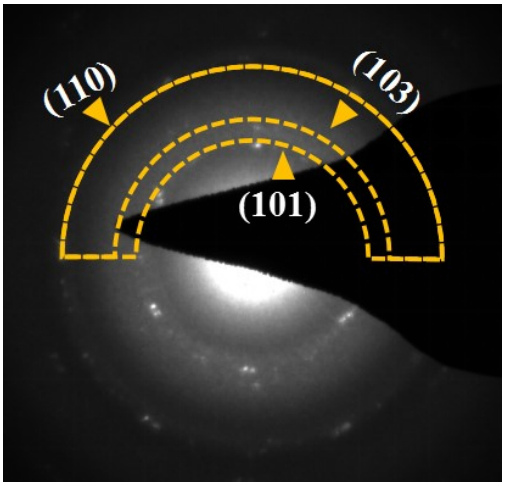

Fig. S1 The SAED images of the 1T-MoS_2-Sb composite.

The ratio of molybdenum and antimony of the samples was characterized by inductively coupled plasma atomic emission spectrometry (ICP-AES). The weight ratio of Mo : Sb in 1T-MoS_2-Sb was 1:0.012. The content of MoS_2 in 1T-MoS_2-Sb (MoS_2 wt%) can be calculated as below:

$m_{MoS2} : m_{Sb}$ = 1: (96 / 160 * 0.012) =1 : 0.0072

MoS_2 wt% = Wremain / M_{MoO_3} * M_{MoS_2} / W 100°C / (1+0.0072) = (95.87%-33.82%) / 144 * 160 / 95.87% / (1+0.0072) = 71.4 wt%.

Sb wt% = MoS_2 wt% * 0.0072 = 0.5%

W 100°C: The weight retained at the temperature of 150°C.

The content of MoS_2 in 2H-MoS_2-1 (MoS_2 wt%) can be calculated as:

MoS_2 wt% = Wremain / M_{MoO_3} * M_{MoS_2} / W 100°C=(95.87%-34.05%) / 144 * 160 / 95.87%= 71.6 wt%

The content of MoS_2 in 2H-MoS_2-2 (MoS_2 wt%) can be calculated as:

MoS_2 wt% = Wremain / M_{MoO_3} * M_{MoS_2} / W 100°C=(95.87%-13.86%) / 144 * 160 / 95.87%= 95.0 wt%

The contents of MoS_2, Sb and the chitosan derived carbon in 1T-MoS_2-Sb are ca. 71.4, 0.5 and 28.1%, respectively.

The calculated proportion of MoS_2 in the 1T-MoS_2-Sb, 2H-MoS_2-1 and 2H-MoS_2-2 samples are ca. 71.4, 71.6 and 95.0 wt.%, respectively.

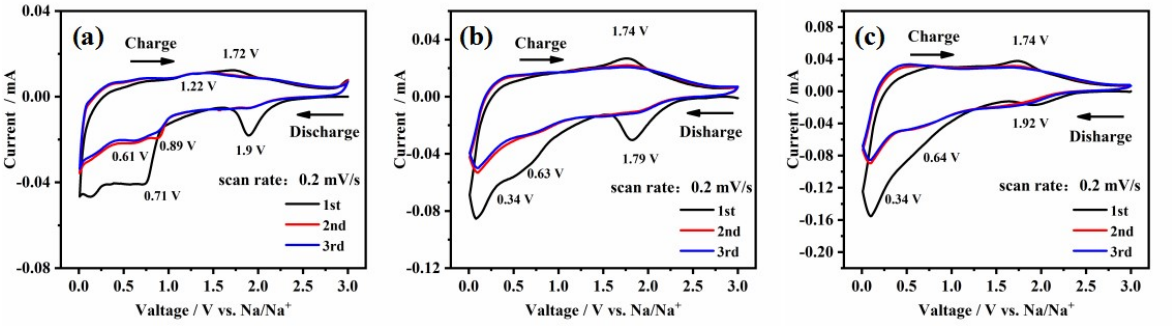

Fig. S2 CV curves of the (a) 1T-MoS_2-Sb, (b) 2H-MoS_2-1 and (c) 2H-MoS_2-2 electrodes at 0.2 mV s^{-1} for SIBs.

Table S1 Comparisons on the electrochemical behavior of 1T-MoS_2-Sb and other reported anodes.

Electrode materials	fields	Cycling capacity (mAh g^{-1})	Current density (A g^{-1})	Cycle numbers	Ref.
1T-MoS_2-Sb	SIBs	494	0.1	50	This work
		253	1	2200	
	PIBs	343	0.1	100	This work
		150	1	1000	
	Full cell	243	0.5	100	This work
1T MoS_2 nanosheets	SIBs	410	0.1	150	16
		324	1	200	
1T-MoS_2-graphene	SIBs	313	0.05	200	30
1T-MoS_2/MoO_x@N	PIBs	209	0.05	100	56
	Full cell	164	0.5	300	56
Activated graphite	PIBs	100	0.2	100	57
NCNTs	PIBs	255	0.05	300	58
		102	2	500	
KMnF-LE	PIBs	110	0.4	10000	59

FeS_2@C	PIBs	292	0.1	300	60
1T-MoS_2@rGO	SIBs	450	0.1	60	S1
		280	1	100	
MoS_2/NCS	PIBs	374	0.05	100	S2
		212	1		
MoS_2@SnO_2@C	SIBs	337	0.1	200	S3
		244	1	1000	
MoS_2-WS_2-C	PIBs	350	0.1	100	S4
MoS_2@HPCS	PIBs	255	0.5	100	S5
		126	1	500	

Refs

[S1] X. Yu, R. Li, X. Hu, R. He, K. Xue, R. Sun, T. Yang, W. Wang and X. Fang, *J. Solid State Chem.,* 2021, **297**, 122027.

[S2] G. Suo, J. Zhang, D. Li, Q. Yu, M. He, L. Feng, X. Hou, Y. Yang, X. Ye, L. Zhang and W. A. Wang, *J. Colloid Interf. Sci.,* 2020, **556**, 427-433.

[S3] Z. Chen, D. Yin and M. Zhang, *Small*, 2018, **14**, 1703818.

[S4] J. H. Choi, G. D. Park and Y. C. Kang, *Chem. Eng. J.,* 2021, **408**, 127278.

[S5] J. Hu, Y. Xie, X. Zhou and Z. Zhang, *ACS Appl. Mater. Interfaces,* 2020, **12**, 1232-1240.