Electronic Supplementary Material (ESI)

Mo_2C-induced solid-phase synthesis of ultrathin MoS_2 nanosheet arrays on bagasse-derived porous carbon frameworks for high-energy hybrid sodium-ion capacitors

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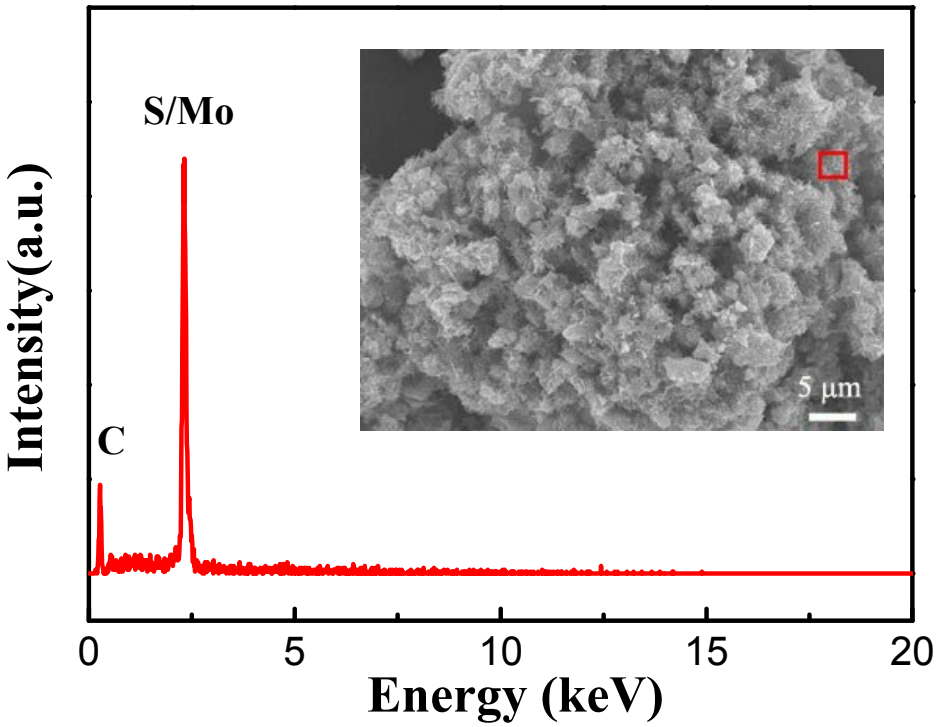

Fig. S1 EDX spectrum of the MoS_2@bagasse-derived porous carbon (BPC) obtained by SEM-EDX analysis.

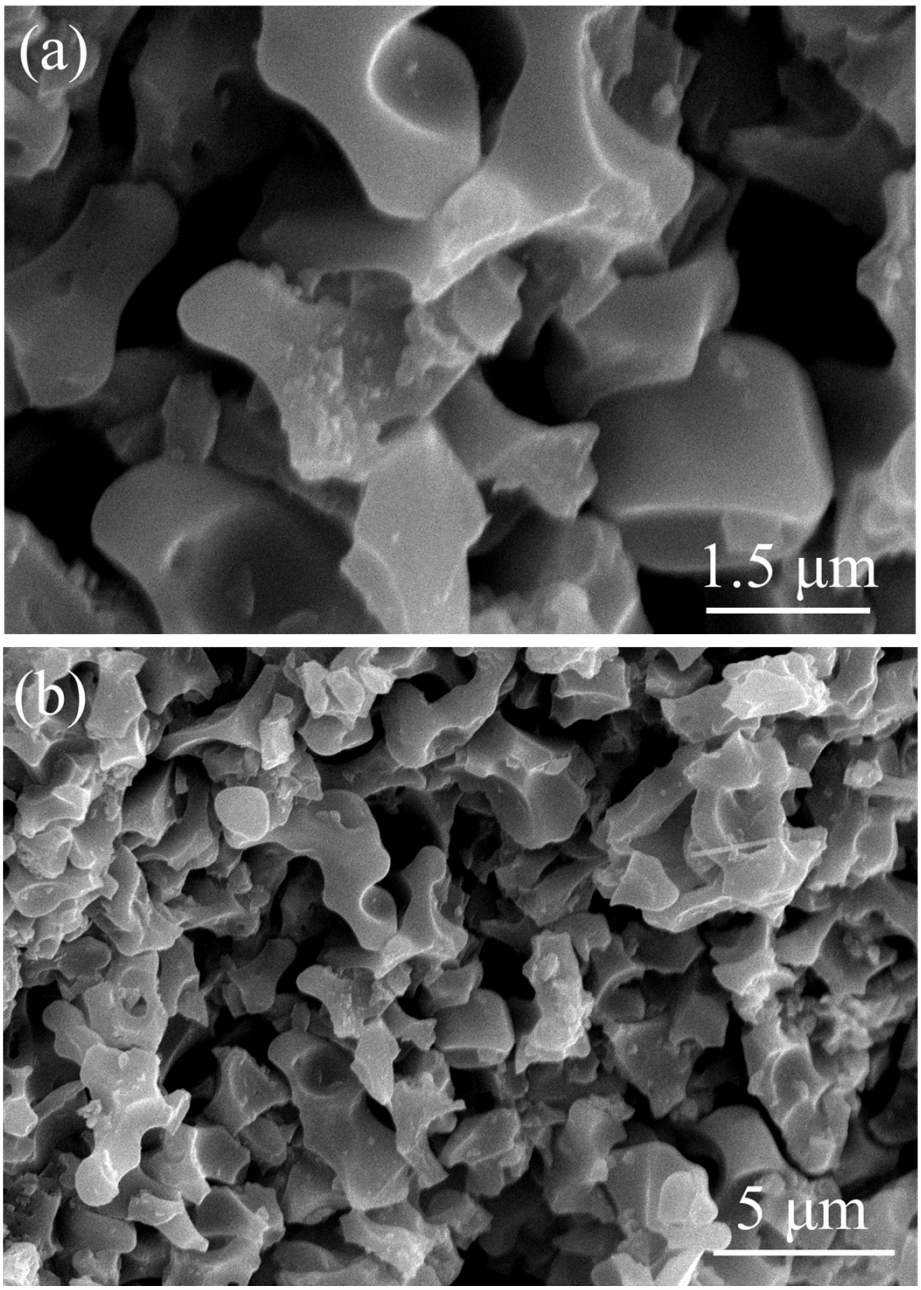

Fig. S2 SEM images of "MoS_2+BPC". The product was prepared by one-step sulfuration of the "BPC+S+$(NH_4)_6Mo_7O_{24}\cdot 4H_2O$" mixture.

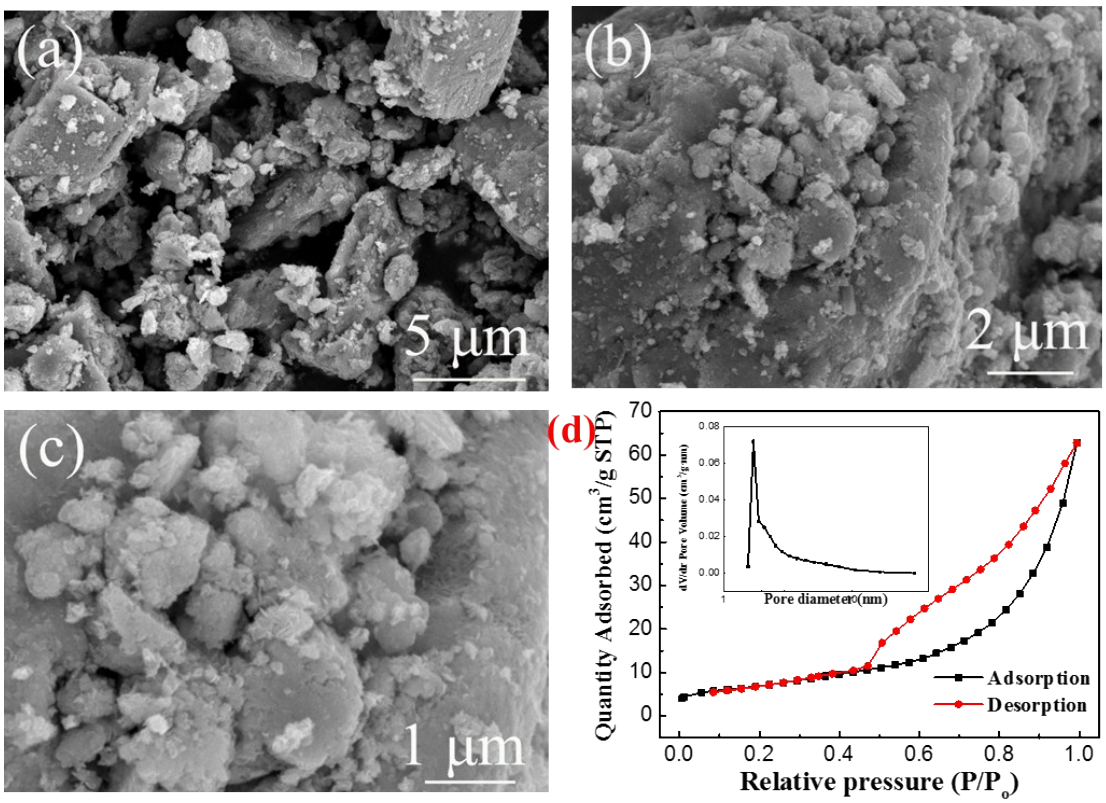

Fig. S3 (a-c) FESEM images and (d) N_2 adsorption-desorption isotherms and porosity distribution of pure MoS_2 sample, which was obtained by annealing the "sulfur + $(NH_4)_6Mo_7O_{24}\cdot 4H_2O$" mixture.

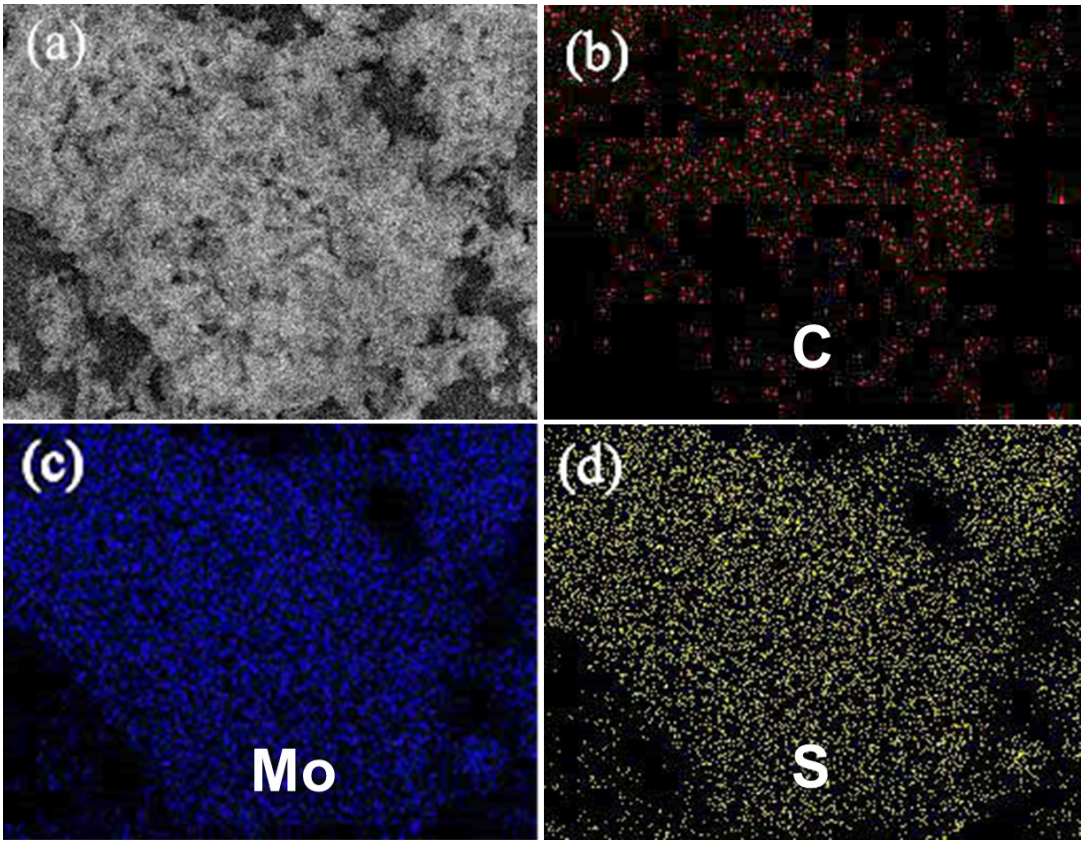

Fig. S4 Morphologies (a) of the MoS_2@BPC composite. (b-d) elemental mapping images of b) C, c) Mo, and d) S.

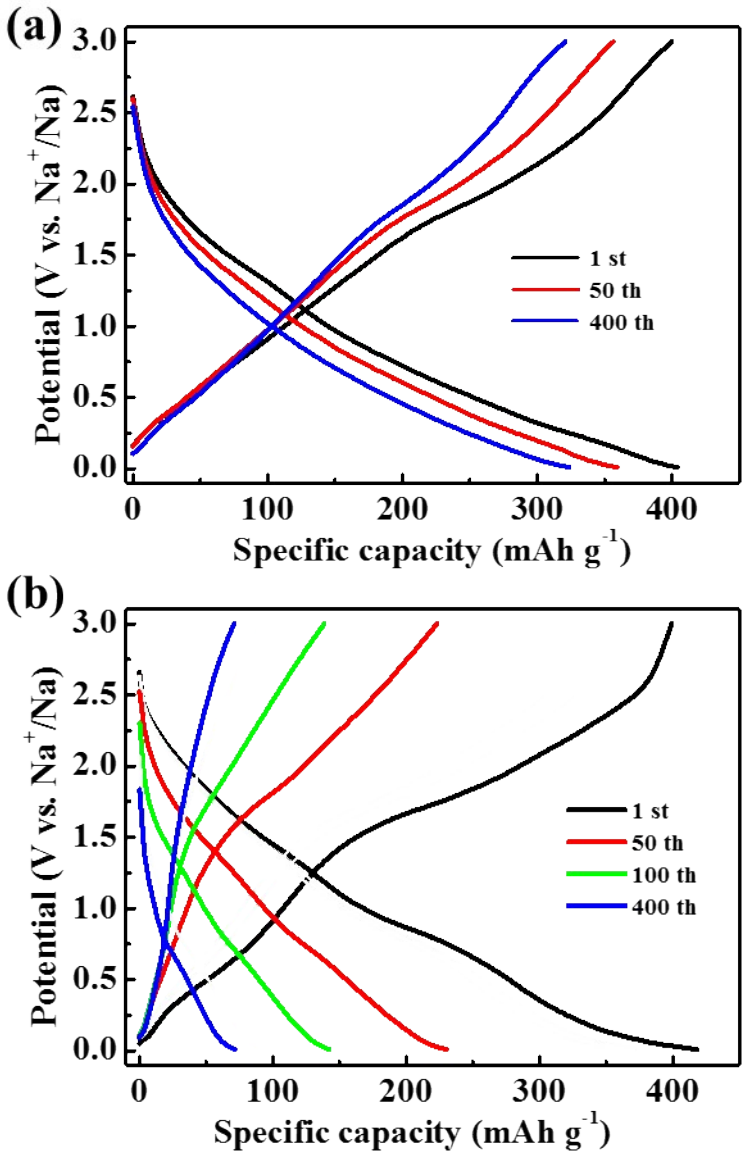

Fig. S5 GCD curves of MoS_2@BPC (a) and pure MoS_2 (b) at 0.2 Ag^{-1}.

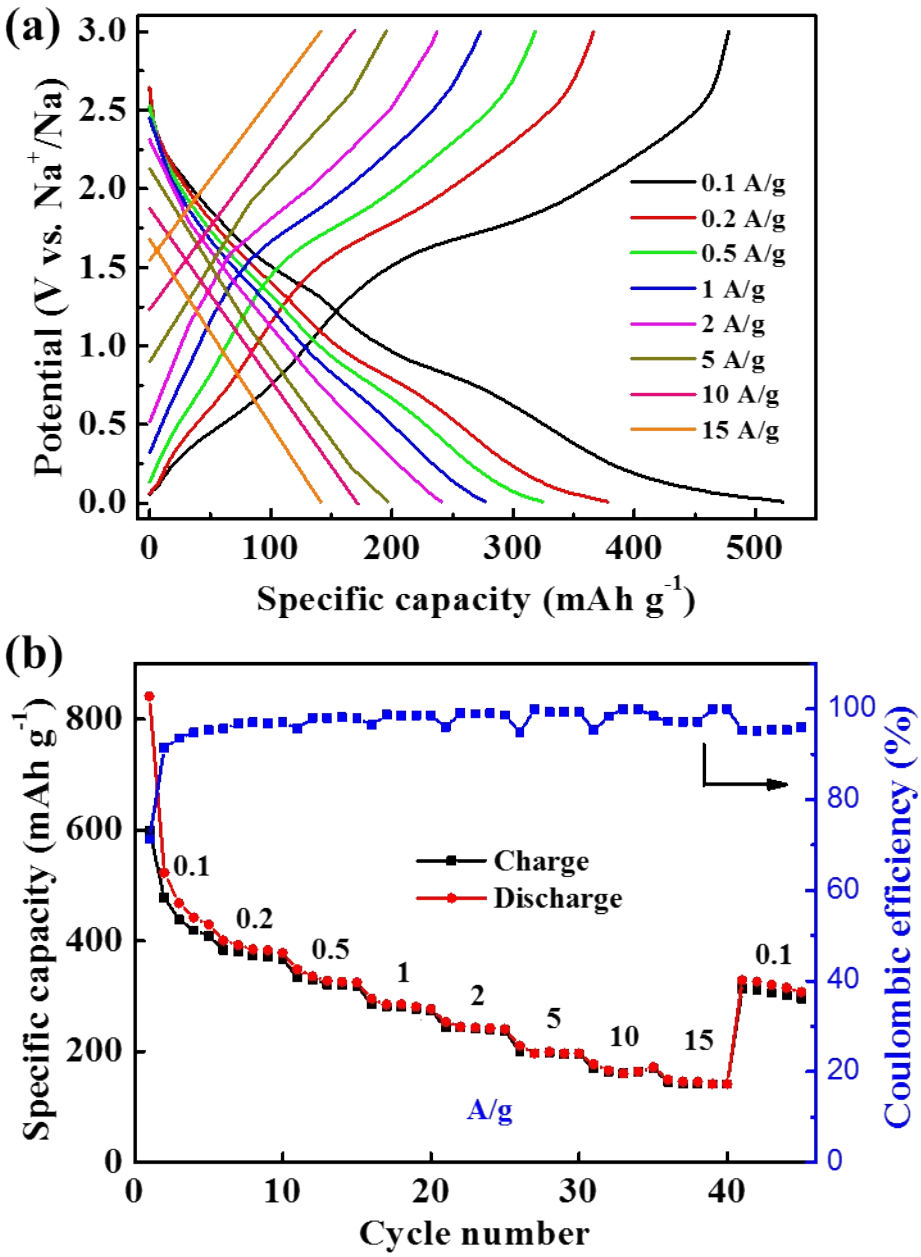

Fig. S6 (a) GCD curves and (b) Rate performance of the pure MoS_2 electrode.

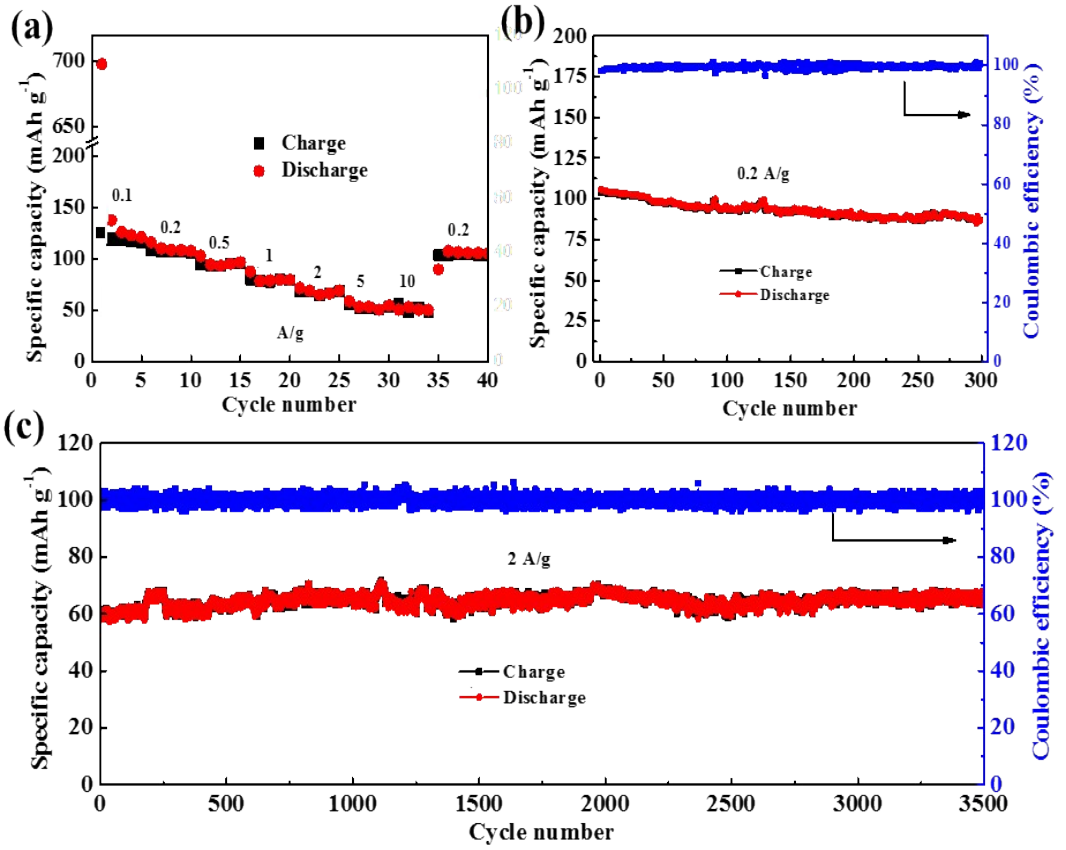

Fig. S7 (a) Rate performance and cycling performance at (b) 0.2 A g^{-1} and (c) 2 A g^{-1} of the BPC electrode in the range of 0.01–3 V (*vs* Na/Na^{+}).

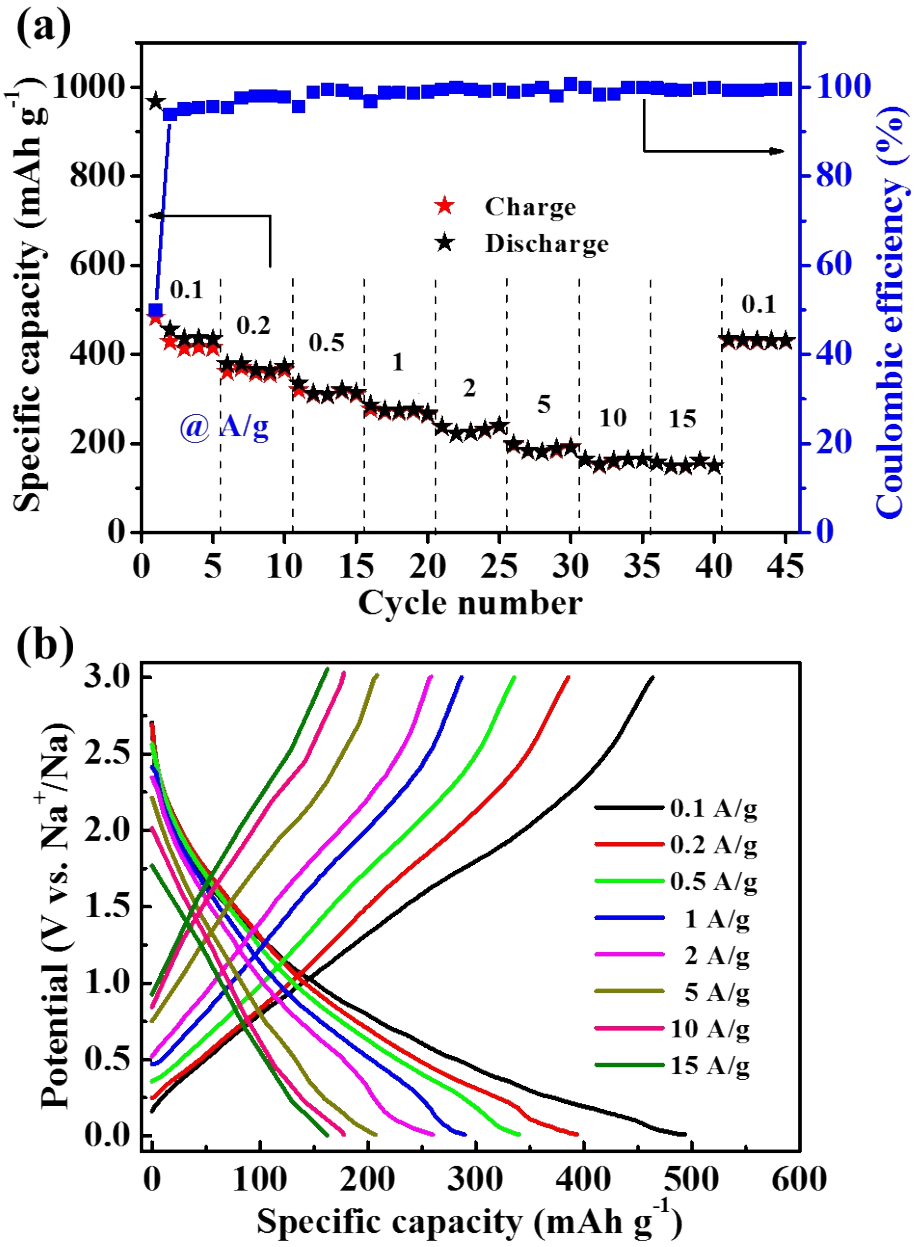

Fig. S8 (a) Rate performance and (b) GCD curves at different current densities of the MoS_2@BPC electrode at the mass loading of 2 mg·cm^{-2}.

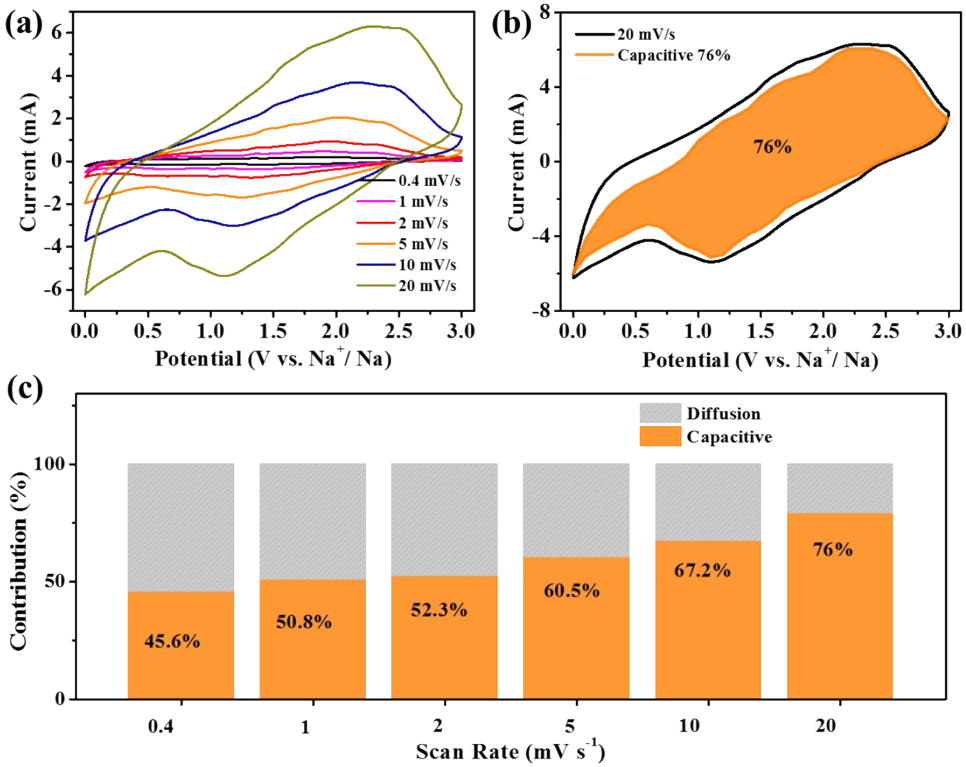

Fig. S9 (a) CV curves of the pure MoS_2 electrode at different scan rates. (b) Voltammetric response at a scan rate of 20 mV s^{-1}. The capacitive contribution to the total current is shown by the shaded region. (c) Normalized contribution ratio of capacitive capacities at different scan rates.

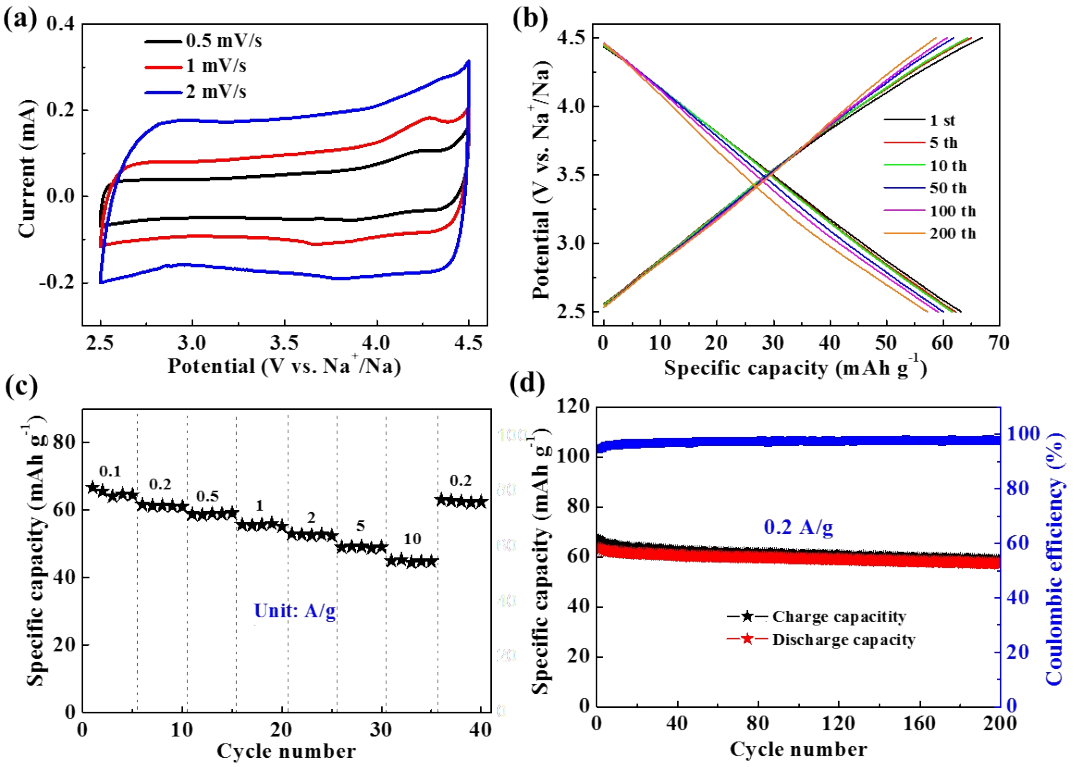

Fig. S10 (a) CV curves at different scan rates, (b) GCD curves, (c) Rate performance, and (d) Cycling performance at 0.2 A g^{-1} of BPC in the range of 2.5–4.5 V (*vs* Na/Na^+) as the cathode of NICs.

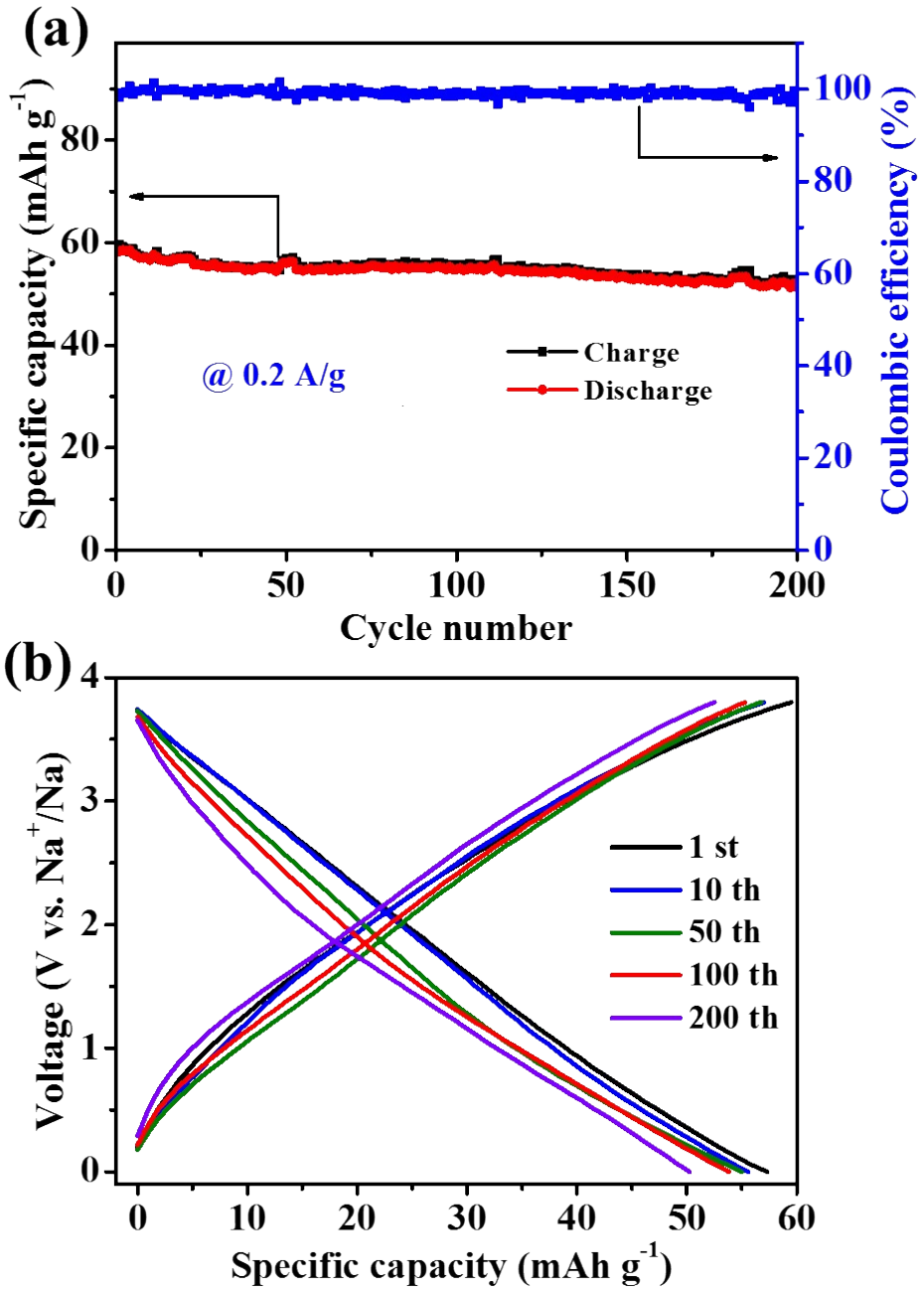

Fig. S11 (a) Cycling performances and (b) the corresponding GCD curves of the MoS_2@BPC//BPC NIC at 0.2 A g^{-1}.

Table S1 Comparison of cycle performance and rate performance for MoS_2@BPC anodes with the previous reports.

Materials	Voltage Range (V)	Cycle performance		Rate performance		Refs.
		Capacity ($mAhg^{-1}$) /cycles	Current density($A \cdot g^{-1}$)	Capacity ($mAhg^{-1}$)	Current density ($A \cdot g^{-1}$)	
MoS_2 nanoflowers	0.01-3	~250/300	0.2	200, 175	1, 10	1
MoS_2 Nanosheets	0.01-3	386/100	0.04	530, 330, 305, 251	0.04, 0.08, 0.16, 0.32	2
		251/100	0.32			
3D MoS_2-Graphene Microspheres	0.001-3	480/50	0.2	427, 355, 306, 273, 234	1, 3, 5, 7, 10	3
		322/600	1.5			
MoS_2@RGO	0.01-3	420/600	0.1	450, 400, 280	0.1, 0.2, 2	4
		284/600	1			
MoS_2-RGO	0.005-2.5	305/50	0.1	305, 273, 245, 214	0.1, 0.25, 0.5, 1	5
MoS_2-Graphene	0.01-3	340/50	0.1	~390, ~350, ~300, 230	0.05, 0.5, 2, 5	6
		300/500	1			
3D MoS_2 nanosheet/CNTs	0.005-2.5	504.6/100	0.05	504.6, 328.4	0.05, 0.5	7
		495.9/80	0.2			
MoS_2/SWNT	0.1-3	390/100	0.2	437, 404, 341, 302, 268, 192	0.05, 0.2, 1, 5, 10, 20	8
		~315/1000	0.5			
E-MoS_2 /carbon fibers	0.01-3	241/700	1	298, 281, 241, 222, 164, 138, 104	0.05, 0.1, 0.5, 1, 5, 10, 20	9
		216/700	2			
Exfoliated MoS_2–C	0.01-2.5	390/100	0.1	~520, 400, 380, 350, 320, 300	0.05, 0.1, 0.2, 0.4, 1, 2	10
MoS_2/porous carbon	0.01-3	404/100	0.1	467, 406, 338, 293, 183, 122	0.1, 0.2, 0.5, 1, 5, 10	11
		280/300	1			
Vertically Aligned MoS_2	0.01-3	286/100	0.08	348, 321, 271, 230, 205	0.04, 0.08, 0.32, 0.64, 1	12

@carbon						
MoS_2/C microspheres	0.05-3	~500/100	0.1	481, 406, 391, 339, 312, 244	0.1, 0.5, 1, 5, 10, 20	13
		390/2500	1			
MoS_2/C nanofibers	0.01-3	283.9/600	0.1	401, 370, 317, 283, 247, 148, 89	0.05, 0.1, 0.2, 0.5, 1, 3, 5	14
MoS_2/Porous Carbon	0.01-3	415/350	0.2	500, 345	0.1, 5	15
		340/550	1			
MoS_2@BPC	0.01-3	332.4/400	0.2	491.5, 420.6, 380.5, 345, 304.4, 251.5, 202.9, 179.8	0.1, 0.2, 0.5, 1, 2, 5, 10, 15	This work
		183.5/5000	2			

Table S2 Energy and power density comparison with the reports in the literature for hybrid NIC devices.

Positive electrode	Negative electrode	Voltage Window (V)	Energy density (Wh kg^{-1})	Corresponding Power density (W kg^{-1})	Refs.
PSC	$Na_2Ti_3O_7$	0.5-3.5	111.2	800	16
			33.2	11200	
rGO	$NaTi_2(PO_4)_3$	0-2.7	334	53	17
			31	6700	
BAC	TiO_2@CNT@C	1-4	126	81.2	18
			37.9	12400	
GFs	$Na_2Ti_3O_7$/CT	1-3	55	200	19
			21.7	3000	
PDPC	TiO_2-RGO	1-4	94.7	247	20
			30.9	4093	
rGO-50	Nb_2O_5@C	1-4.3	76	80	21
			6	20800	
AC	$NaTi_2(PO_4)_3$	0.01-2.5	56	39	22
			31	4096	
AC	Ti(O,N)-MP-NWs	0.5-4	46	46	23
			10.9	11500	
PSC	Nb_2O_5 nanosheets	1-3	43.2	160	24
			24	5760	
AC	Na-TNT	0-3	34	889	25
AC	N-TiO_2	1-4	80.3	500	26
			24.6	12500	
PSC	NTO@CNT	0-3	58.5	300	27
			21.6	3000	
CFs	TiO_2/CFC	1.2-4.3	73.8	550	28
			20.5	13750	
NVP–AHD	nanoporous carbon	0.2-2.7	15	5424	29
AC	MWTOG	1-3.8	64.2	56.3	30
			25.8	1367	
BPC	BPC/MoS_2	0-4	112.2	55	This work
			53.2	8333	

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