Electronic Supporting Information

Controllable synthesis of nitrogen-doped carbon nanobubbles to realize high-performance for lithium and sodium storage

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Electronic Supplementary Information contains Fig. S1-S6 and Table S1-S3.

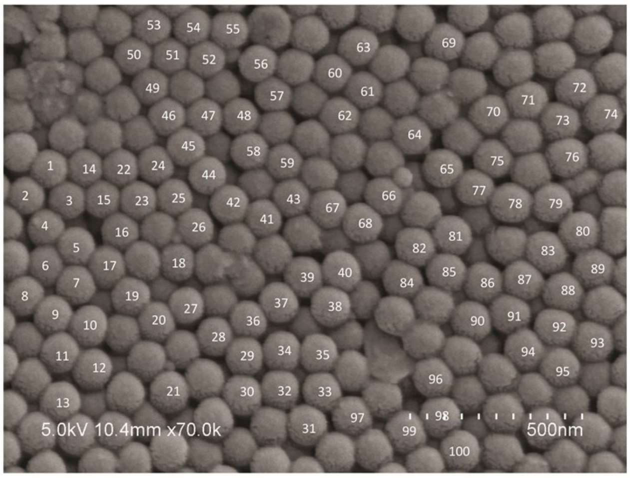

Fig. S1 SEM image of PS spheres and the randomly selected 100 particles.

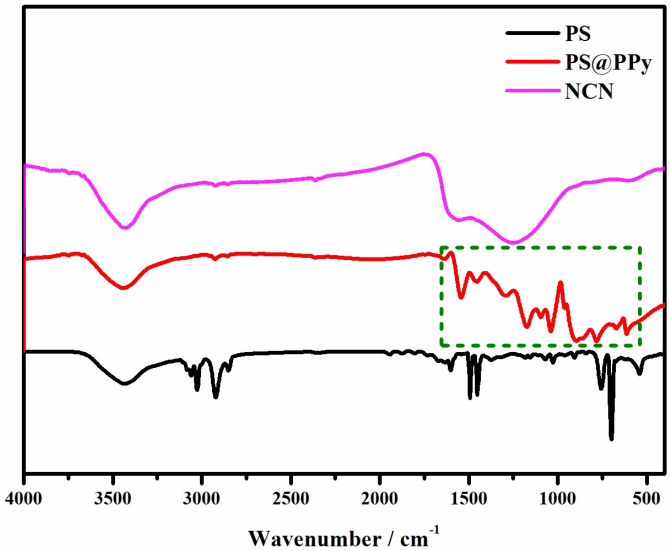

Fig. S2 FTIR spectrum of PS, PS@PPy, PS@PPy with THF washing, and NCN, respectively.

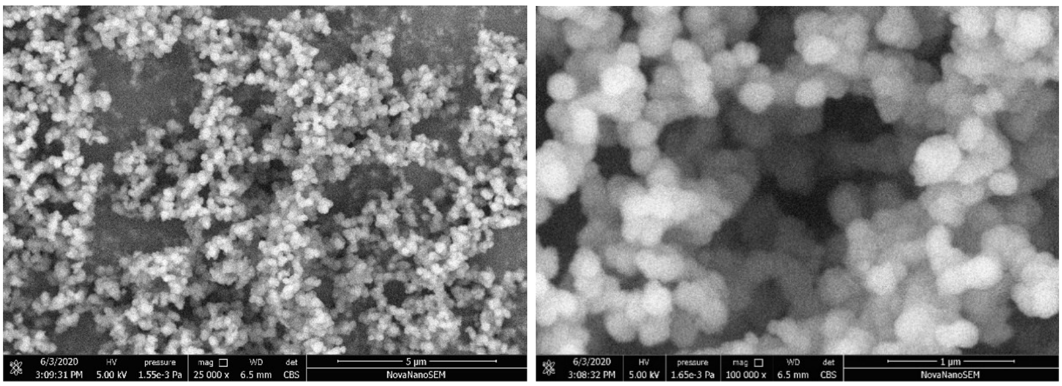

Fig. S3 SEM images of PPy-C at different magnifications.

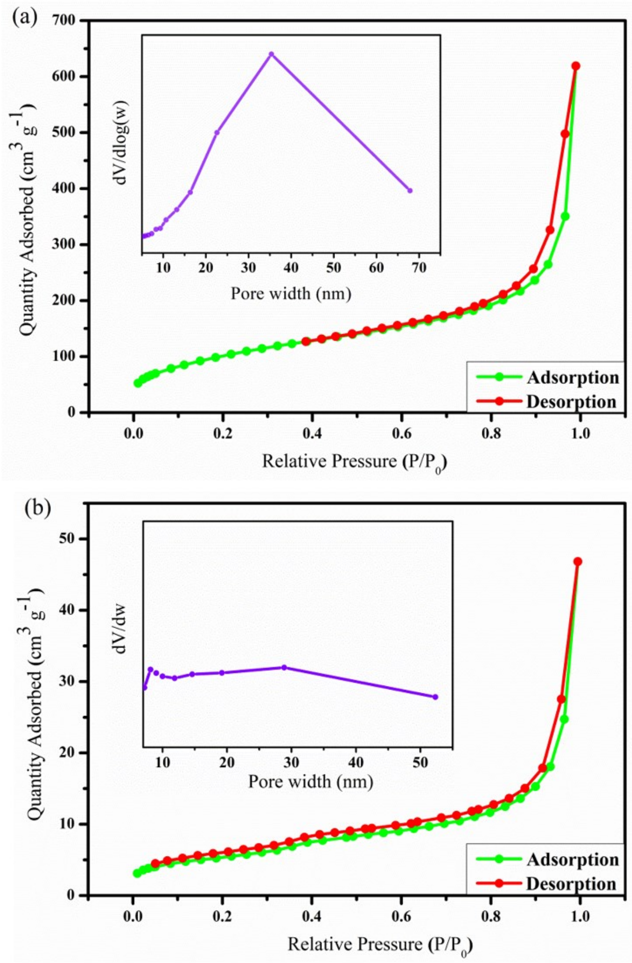

Fig. S4 Nitrogen sorption isotherms and pore distributions of (a) NCN and (b) PPy-C.

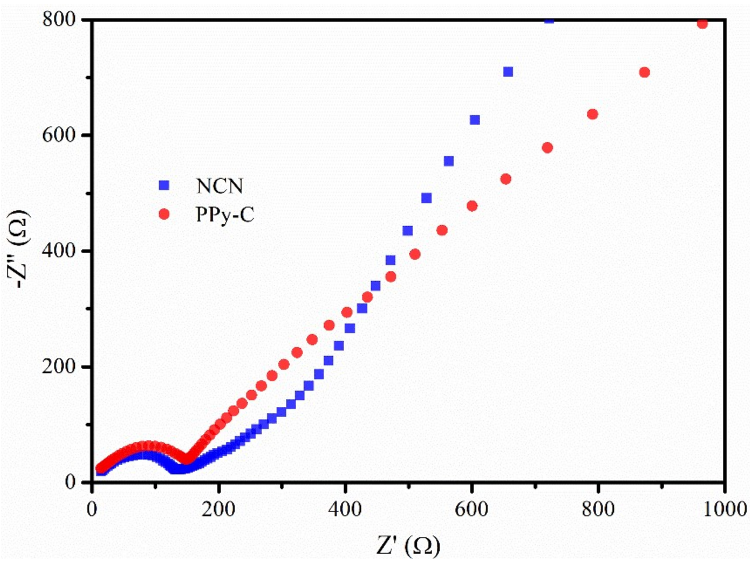

Fig. S5 Nyquist plots of NCN and PPy-C electrode before testing.

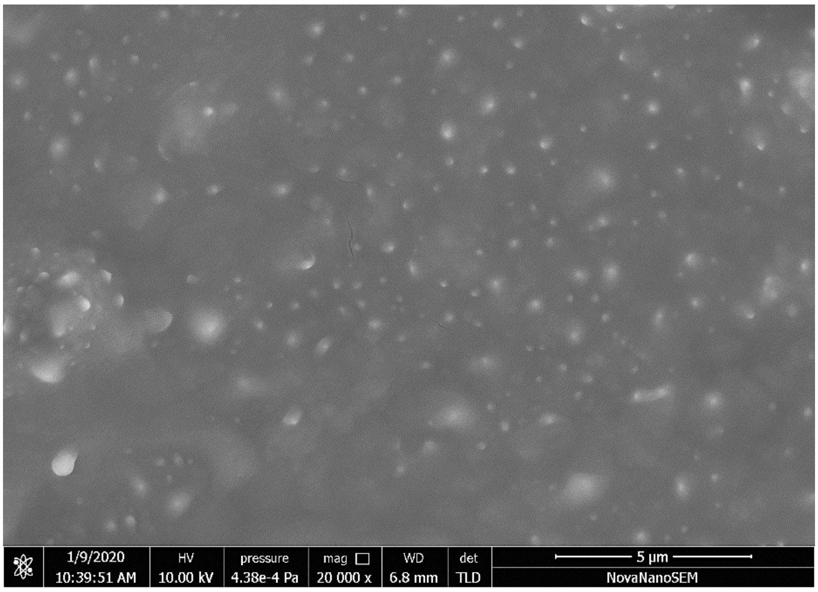

Fig. S6 SEM image of NCN electrode after charging-discharging for 1000 cycles.

Table S1. Size statistics of PS nanospheres based on 100 selected particles

NO.	Particle size (nm)	NO.	Particle size (nm)	NO.	Particle size (nm)	NO.	Particle size (nm)
1	108.3	26	103.7	51	103.7	76	115.2
2	110.6	27	103.7	52	108.3	77	106.0
3	106.0	28	110.6	53	101.4	78	119.8
4	106.0	29	110.6	54	108.3	79	112.9
5	106.0	30	115.2	55	110.6	80	115.2
6	103.7	31	110.6	56	110.6	81	117.5
7	112.9	32	110.6	57	103.7	82	117.5
8	112.9	33	110.6	58	106.0	83	119.8
9	108.3	34	112.9	59	103.7	84	112.9
10	112.9	35	110.6	60	106.0	85	110.6
11	106.0	36	117.5	61	106.0	86	110.6
12	115.2	37	117.5	62	110.6	87	117.5
13	117.5	38	112.9	63	106.0	88	115.2
14	103.7	39	115.2	64	110.6	89	110.6
15	101.4	40	122.1	65	108.3	90	115.2
16	106.0	41	106.0	66	112.9	91	110.6
17	117.5	42	108.3	67	108.3	92	117.5
18	103.7	43	106.0	68	117.5	93	122.1
19	110.6	44	108.3	69	108.3	94	115.2
20	112.9	45	106.0	70	112.9	95	115.2
21	110.6	46	106.0	71	108.3	96	115.2
22	99.1	47	108.3	72	119.8	97	115.2
23	103.7	48	103.7	73	115.2	98	119.8
24	106.0	49	106.0	74	115.2	99	119.8
25	96.8	50	106.0	75	112.9	100	112.9

Table S2. Comparison of the electrochemical performance of carbon-based anodes for LIBs

Samples	Cycle performance	ICE (%)	Ref.
N-doped porous carbon	1105 mA h g^{-1} (100th) / 1 A g^{-1}	62	1
Carbon nanofiber	391 mA h g^{-1} (1000th) / 10 A g^{-1}	53	2
N-doped porous hard carbon	673 mA h g^{-1} (100th) / 0.05 A g^{-1}	58	3
Seaweed-derived carbon	348 mA h g^{-1} (3000th) / 5 A g^{-1}	67	4
Porous carbon	335.9 mA h g^{-1} (1000th) / 0.1 C	51	5
Oxygen-riched porous carbon nanosheets	742.8 mA h g^{-1} (100th) / 0.1 A g^{-1}	80	6
N-rich carbon nanotubes	343 mA h g^{-1} (1800th) / 1 A g^{-1}	68	7
Porous carbon	900 mA h g^{-1} (100th) / 0.1 A g^{-1}	47	8
Honeycomb-like carbon	609 mA h g^{-1} (500th) / 1 A g^{-1}	45	9
P-doped mesoporous carbon	180 mA h g^{-1} (10000th) / 10 A g^{-1}	49	10
S-doped mesoporous carbon	250 mA h g^{-1} (500th) / 0.2 A g^{-1}	61	11
Petroleum coke derived porous carbon	407 mA h g^{-1} (500th) / 3.72 A g^{-1}	52	12
N/S co-doped carbon	653 mA h g^{-1} (500th) / 5 A g^{-1}	75	13
N/P co-doped carbon	740 mA h g-1 (2000th) / 2 A g^{-1}	74	14
CO_2 derived porous carbon	630 mA h g^{-1} (200th) / 0.2 A g^{-1}	37	15
Pomegranate-like porous carbon	650 mA h g^{-1} (500th) / 0.2 A g^{-1}	91	16
N-doped porous carbon	500 mA h g^{-1} (500th) / 0.1 A g^{-1}	67	17
N-doped porous carbon	799 mA h g^{-1} (385th) / 0.8 A g^{-1}	80	This work

Table S3. Comparison of the electrochemical performance of carbon-based anodes for SIBs

Samples	Cycle performance	ICE (%)	Ref.
N-doped porous carbon	242 mA h g^{-1} (2500th) / 1 A g^{-1}	25	18
N/S co-doped mesoporous carbon	247 mA h g^{-1} (600th) / 0.5 A g^{-1}	22	19
Aurilave-like carbon	107 mA h g^{-1} (1000th) / 2 A g^{-1}	42	20
Hard carbon	80 mA h g^{-1} (600th) / 0.1 A g^{-1}	66	21
S/P co-doped carbon	290 mA h g^{-1} (1000th) / 1 A g^{-1}	54	22
Porous hard carbon	100 mA h g^{-1} (3000th) / 5 A g^{-1}	77	23
P-doped hard carbon	210 mA h g^{-1} (3000th) / 0.3 A g^{-1}	72	24
Hard carbon microsphere	186 mA h g^{-1} (250th) / 0.4 C	88	25
N/P co-doped carbon	260 mA h g^{-1} (150th) / 0.1 A g^{-1}	76	26
Lignin-derived hard carbon	280 mA h g^{-1} (250th) / 0.2 A g^{-1}	71	27
Carbon nanosheets	309 mA h g^{-1} (200th) / 0.2 A g^{-1}	58	28
S-doped carbon	290 mA h g^{-1} (100th) / 1 A g^{-1}	47	29
Carbon nanocups	212 mA h g^{-1} (1000th) / 1.5 A g^{-1}	34	30
N/S co-doped carbon	75 mA h g^{-1} (10000th) / 5 A g^{-1}	34	31
Porous carbon sheets	110 mA h g^{-1} (500th) / 0.5 A g^{-1}	-	32
N-doped porous carbon	248 mA h g^{-1} (200th) / 0.3 A g^{-1}	79	This work

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