

Electronic Supplementary Information

Covalent Sulfur Embedding in Inherent N, P Co-doped Biological

Carbon for Ultrastable and High Rate Lithium-Sulfur Batteries

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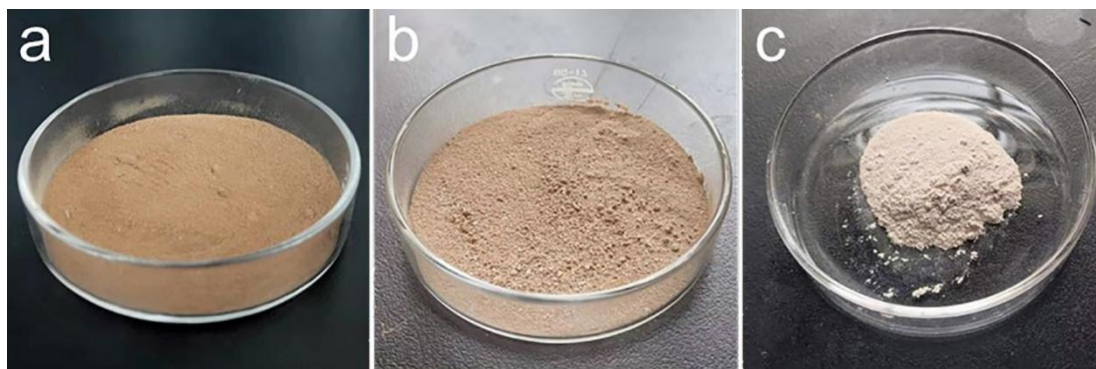


Fig. S1. (a) Digital photos of GPBBS before being activated. (b) GPBBS after being activated, edulcorated, centrifuged and dried. (c) GPBBS mixed with sulfur by ball milling. The color gradually became light.

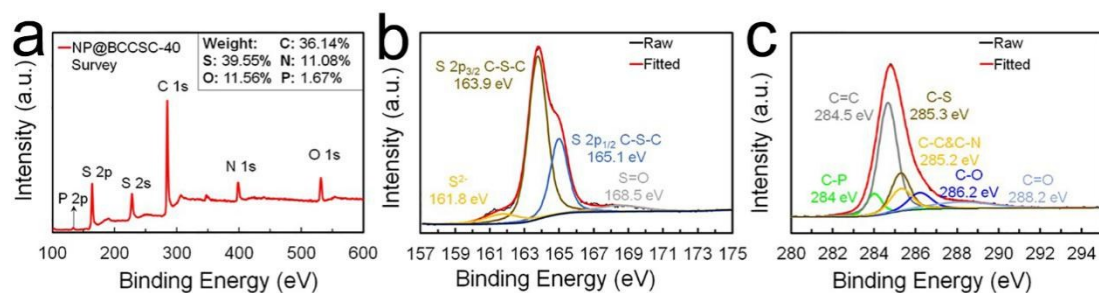


Fig. S2. (a) XPS survey of NP@BCCSC-40; High definition of (b) C 1s and (c) S 2p spectrum

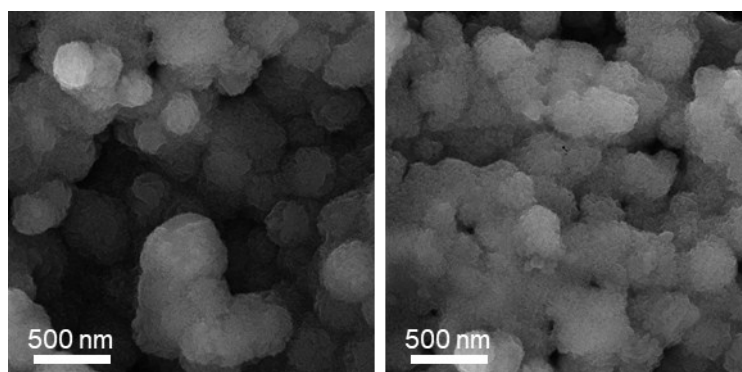


Fig. S3. SEM images of NP@BCCSC after 500 cycles.

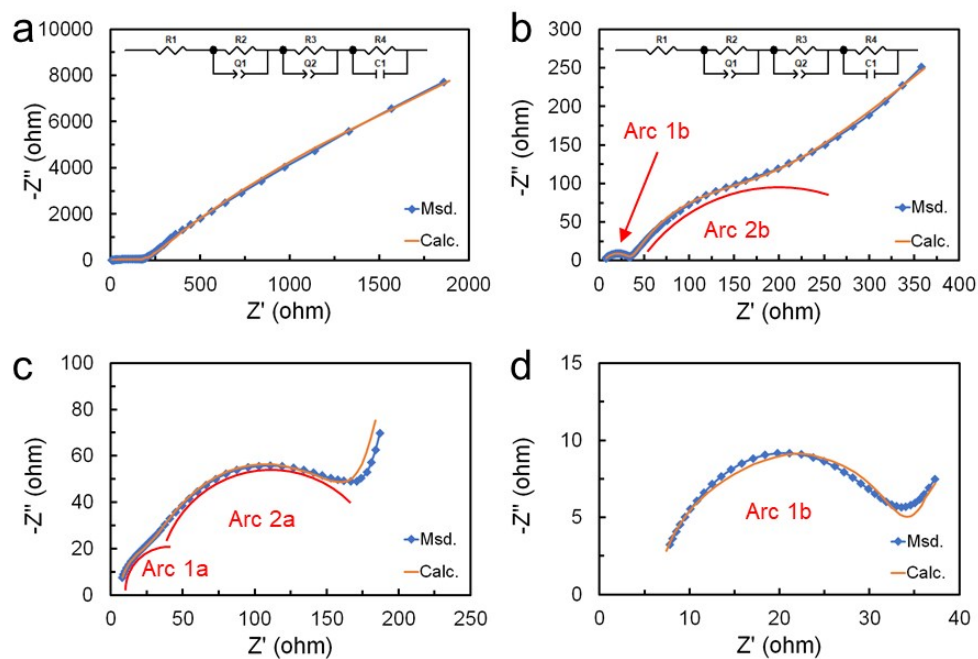


Fig. S4. (a) Impedance curve of NP@BCCSC before cycling. (b) Impedance curve of NP@BCCSC after 500 cycles. (c) The enlarged view of kinetic control impedance of (a), after cycling (d).

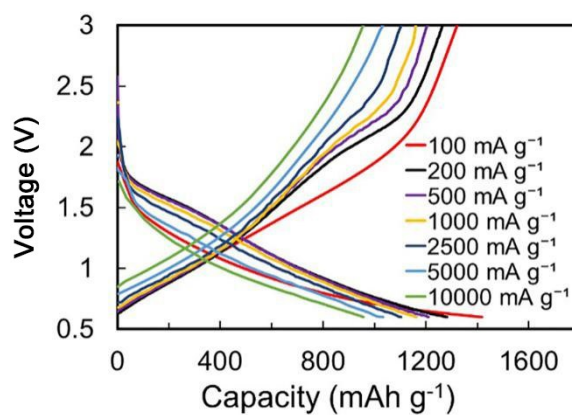


Fig. S5. Charge and discharge curves of NP@BCCSC-20 in different current densities.

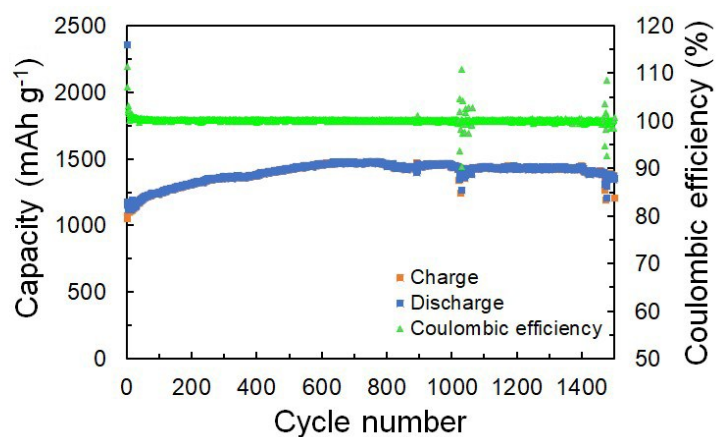


Fig. S6. Long cyclic stability of NP@BCCSC-20 cathode with high mass loading of 6.22 mg cm^{-2} when the current density is 500 mA g^{-1} .

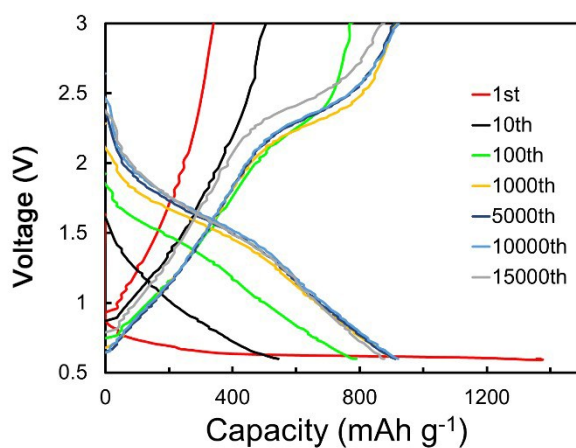


Fig. S7. Charge and discharge curves of NP@BCCSC-20 in different cycles under the current density of 10000 mA g^{-1} .

Table S1. Components parameters and error in the impedance fitted circuit.

Component	Before cycling	After cycling
R1/ohm	0.1472	5.598
Q1(CPE)/(S·sec ⁿ)	3.837E-5, n=0.5812	0.001736, n=0.75
R2/ohm	200	293.6
Q2(CPE)/(S·sec ⁿ)	0.0001755, n=0.8981	2.139E-5, n=0.75
R3/ohm	6.729E5	29.05
C1/F	0.0007876	0.0001538
R4/ohm	1071	816.6
Error	Error=9.70E-4	Error=5.38E-4

Table S2. Comparison of capacity decay rates between this work and previous reported works.

Electrode materials	Current	Capacity retention	Cycles	Decay per cycle	Refs
PSDHC-600A	2 C	29%	1000	0.071%	1
GOC@NPBCS	5 C	55%	1000	0.045%	2
Li ₂ S@C-CNT	1 C	89%	220	0.050%	3
CS-LSP	0.5 C	97.6%	300	0.008%	4
FMSiNP	1 C	43%	1500	0.038%	5
MoS ₂ /Celgard	0.5 C	50.2%	600	0.083%	6
CC/TiO ₂ /S	0.2 C	78%	700	0.031%	7
Ti ₃ C ₂ T _x foam/S-1.5	1 C	75%	1000	0.025%	8
S/YSC@Fe ₃ O ₄	0.1 C	85.4%	200	0.073%	9
Mn ₃ O ₄ array@CC/S	2 C	40%	3000	0.020%	10
NP@BCCSC-20	6 C (2000 mA g ⁻¹)	64%	15000	0.0024%	This work
NP@BCCSC-40	0.75 C (500 mA g ⁻¹)	21%	500	0.158%	This work

Reference

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