Synergistic Effects of B/S Co-doped Spongy-like Hierarchically Porous Carbon for High Performance Zinc-ion Hybrid Capacitor

Xiaopeng Zhang[a], Yingge Zhang[a], Jialong Qian[a], Yihe Zhang[a,*], Li Sun[a,**], Qi Wang[a]

[a] Beijing Key Laboratory of Materials Utilization of Nonmetallic Minerals and Solid Wastes, National Laboratory of Mineral Materials, School of Materials Science and Technology, China University of Geosciences, Beijing 100083, China.

This supporting information file includes:

Section S1. The XPS survey spectra of and high resolution O1s spectra of the B_xS_yC.

*Corresponding author. E-mail address: zyh@cugb.edu.cn (Y. Zhang).

**Corresponding author. E-mail address: sunli@cugb.edu.cn (L. Sun).

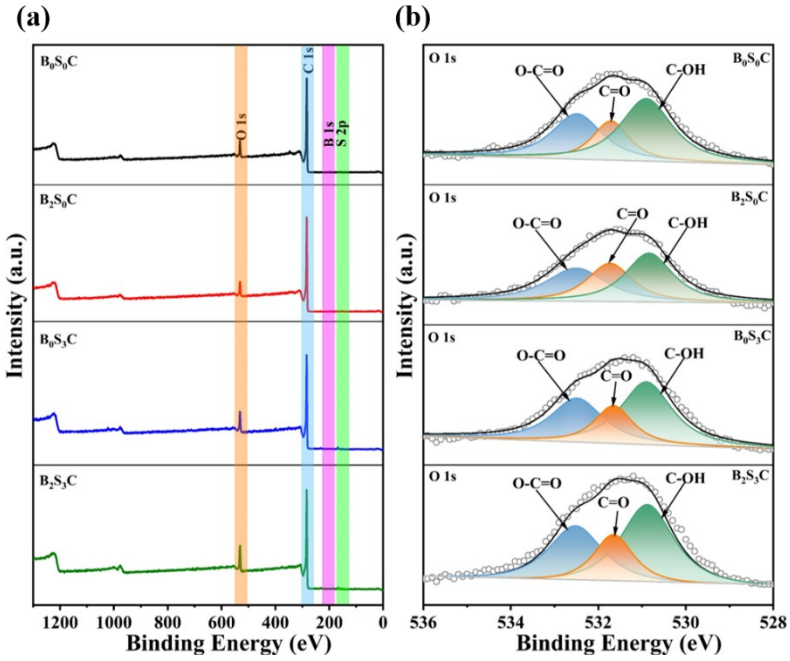

Fig. S1. (a) XPS survey spectra of and (b) high resolution O1s spectra of the B_xS_yC.

Section S2. The electrochemical analysis of B_xS_yC electrodes.

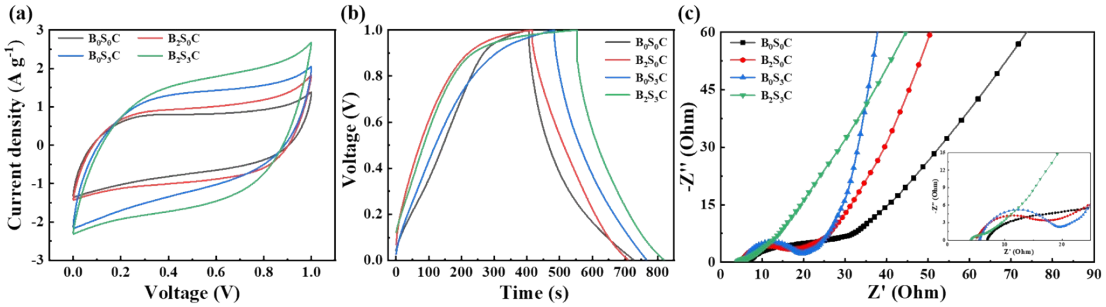

Fig. S2. Electrochemical analysis of B_xS_yC: (a) CV curves at 10 mV s^{-1}, (b) GCD curves at 0.5 A g^{-1}, and (c) Nyquist plots.

Section S3. The GCD curves of B- and/or S atoms with different doping amounts.

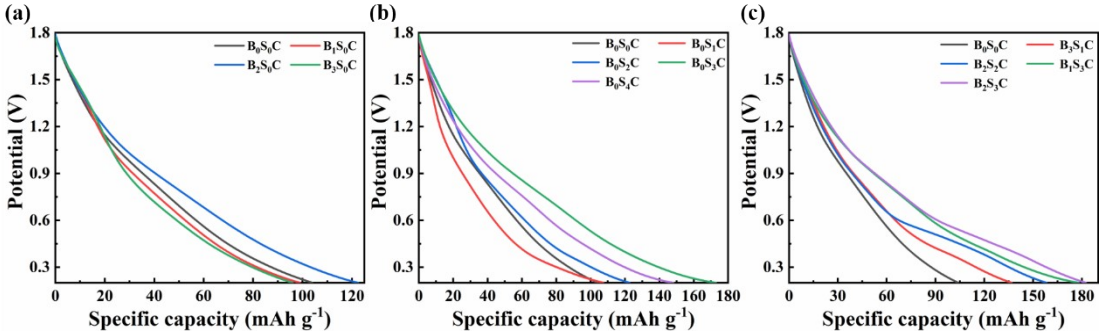

Fig. S3. The GCD curves of (a) B_xS_0C, (b) B_0S_yC and (c) B_xS_yC.

Section S4. The GCD curves of B_2S_3C electrode at different current densities and the CV curves of B_2S_3C at different scanning rates.

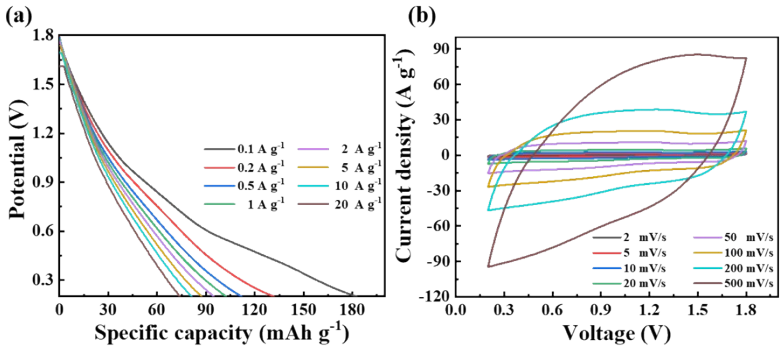

Fig. S4. (a) The GCD curves of B_2S_3C at different current densities, (b) the CV curves of B_2S_3C at different scanning rates.

Section S5. Ragone plot of B_2S_3C electrode compared with recent work.

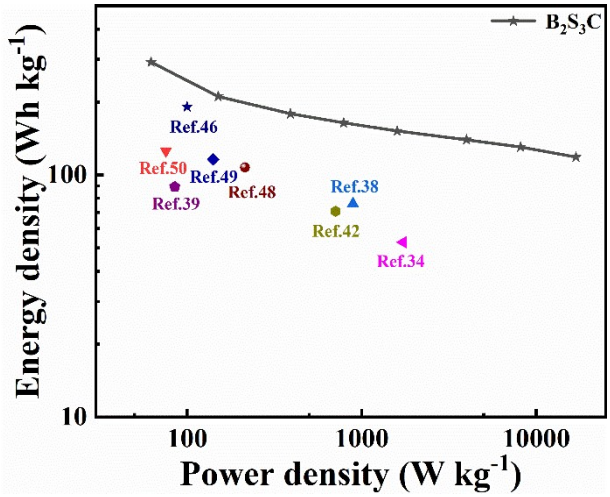

Fig. S5. Ragone plot of B_2S_3C electrode compared with recent work.

Section S6. SEM images of B_2S_3C after 10000 cycles.

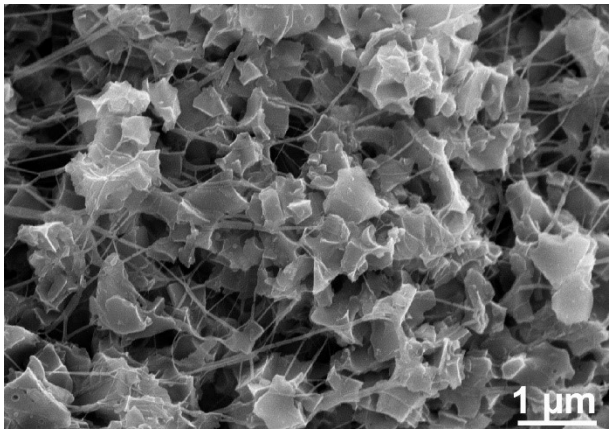

Fig. S6. SEM images of B_2S_3C after 10000 cycles.

Section S7. Contact angles of $ZnSO_4$ solution droplet at the interface of B_2S_3C after 10000 cycles.

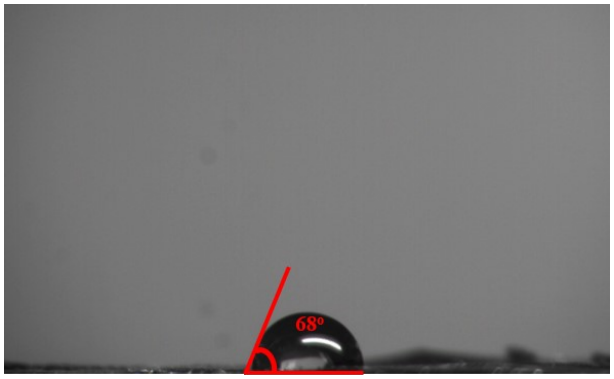

Fig. S7. Contact angles of $ZnSO_4$ solution droplet at the interface of B_2S_3C after 10000 cycles.

Section S8. High-resolution XPS survey of B_2S_3C after several cycling.

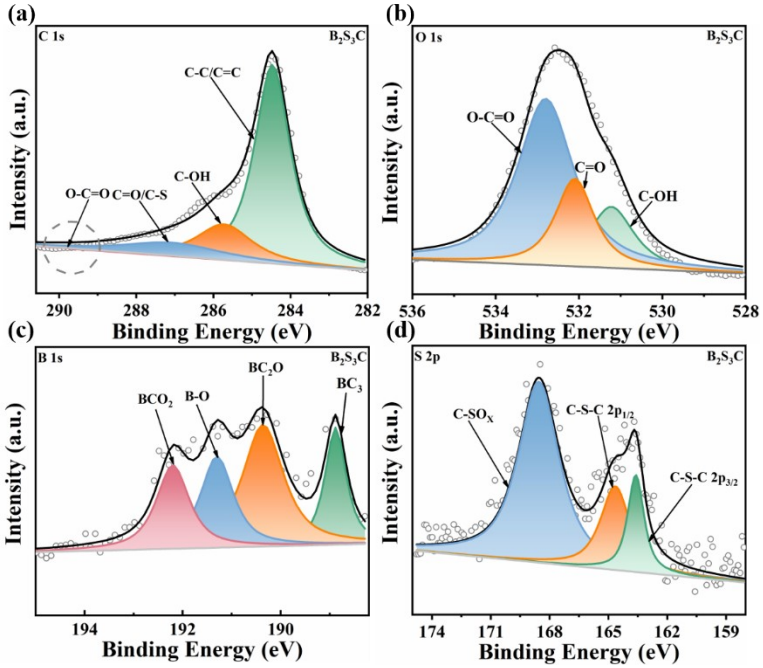

Fig. S8. High-resolution XPS survey of B_2S_3C after several cycling: (a) C 1s, (b) O 1s, (c) B 1s, (d) S 2p.

Section S9. The detailed information about the calculation of energy barrier.

The energy barrier calculation is calculated based on adsorption energy. The calculation formula of the adsorption energy is $\Delta E_{ad} = \Delta E_{C-MO} - (\Delta E_C + \Delta E_{MO})$, where the definition of the values in the formula was listed below:

ΔE_{ad}: adsorption energy of molecule on carbon

ΔE_{C-MO}: The total energy of carbon with molecule adsorpted on

ΔE_C: The total energy of carbon

ΔE_{MO}: The energy of a single molecule

Section S10. Pore structure parameters of B_0S_0C, B_2S_0C, B_0S_3C, and B_2S_3C.

Table S1 Pore structure parameters of B_0S_0C, B_2S_0C, B_0S_3C, and B_2S_3C.

Samples	D_{ap} (nm)	S_{BET} ($m^2\ g^{-1}$)	S_{micro} ($m^2\ g^{-1}$)	V_t ($cm^3\ g^{-1}$)	V_{micro} ($cm^3\ g^{-1}$)
B_0S_0C	1.74	1105	1033	0.39	0.401
B_2S_0C	1.92	1507	1249	0.62	0.501
B_0S_3C	2.44	2269	209	1.09	0.131
B_2S_3C	2.56	2364	565	1.13	0.258

Section S11. Contents of C, O, B, and S elements in B_0S_0C, B_2S_0C, B_0S_3C, and B_2S_3C.

Table S2 Contents of C, O, B, and S elements in B_0S_0C, B_2S_0C, B_0S_3C, and B_2S_3C.

Samples	C1s (%)	O1s (%)	B1s (%)	S2p (%)
B_0S_0C	93.39	6.61	0.00	0.00
B_2S_0C	92.28	6.81	0.91	0.00
B_0S_3C	89.57	9.05	0.00	1.38
B_2S_3C	88.05	9.66	0.91	1.38