Supporting Information

Ultrathin Bismuth Nanosheets as Efficient Polysulfide Catalyst for High Performance Lithium-Sulfur Battery

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Supporting Figures

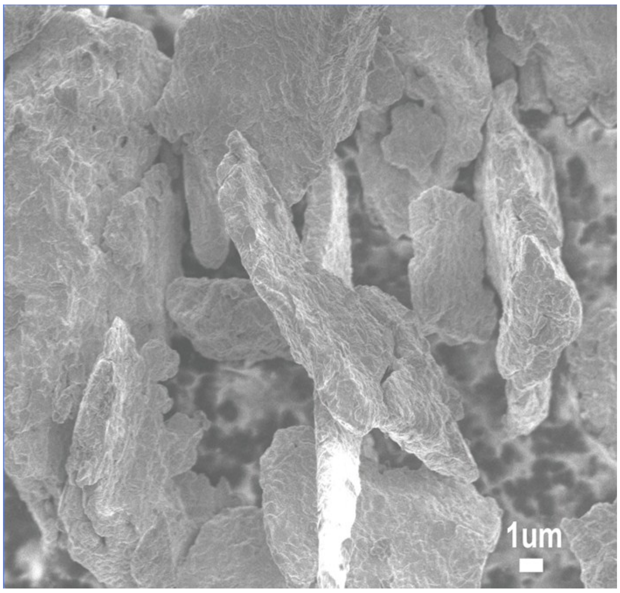

Figure S1. SEM image of commercial Bi bulk

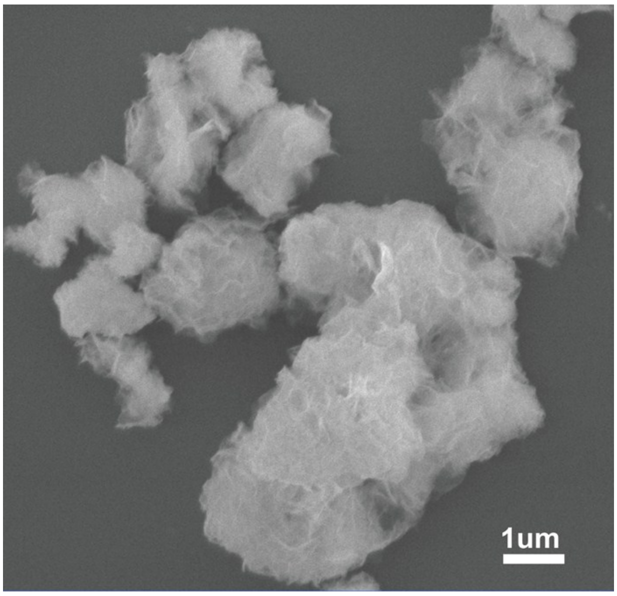

Figure S2. SEM image of BiOC

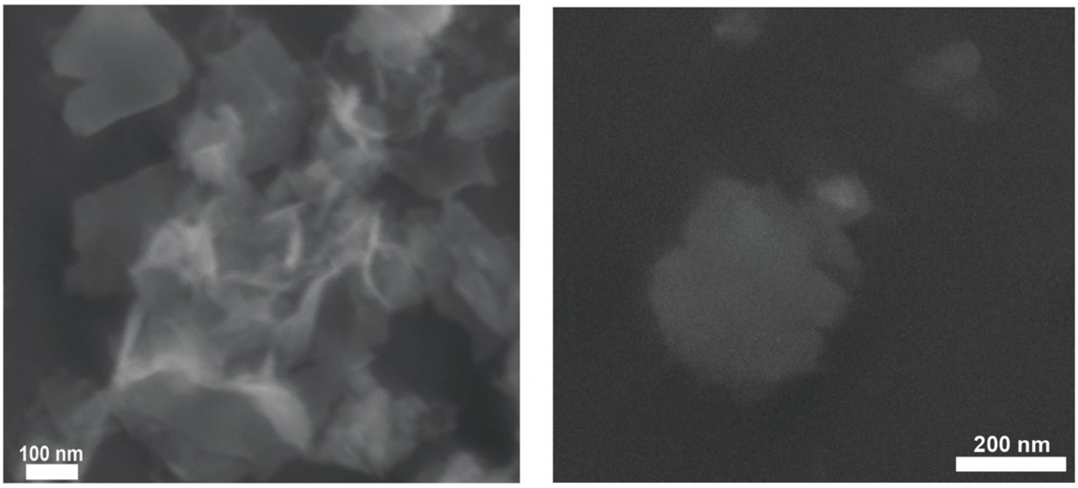

Figure S3. Dispersive 2D-Bi nanosheets under SEM.

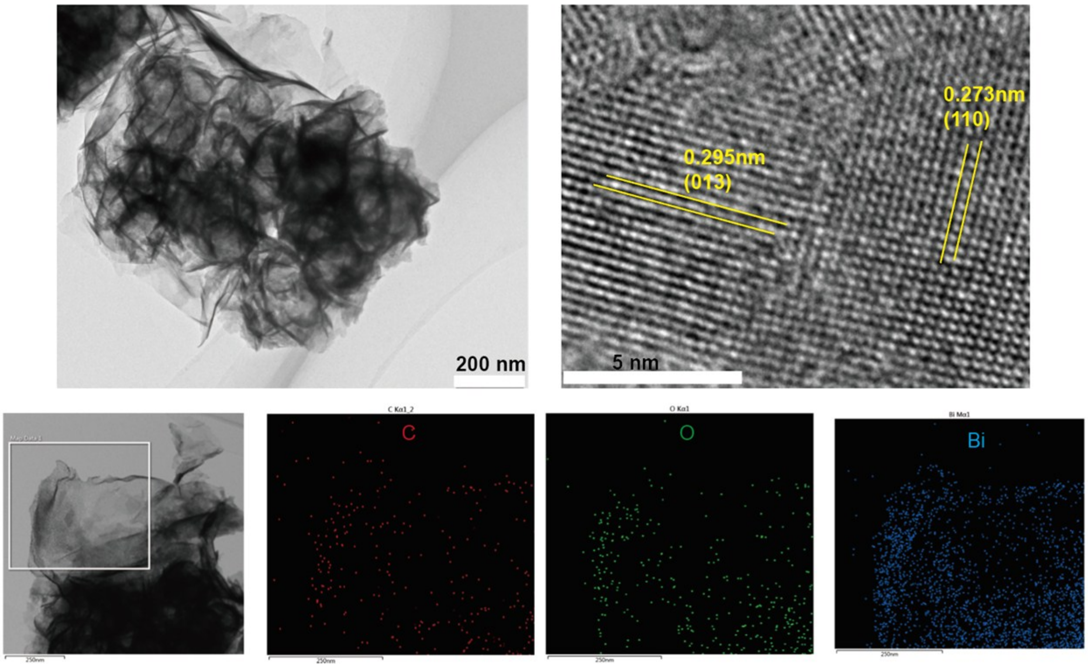

Figure S4. HRTEM image and corresponding elements distribution of BiOC.

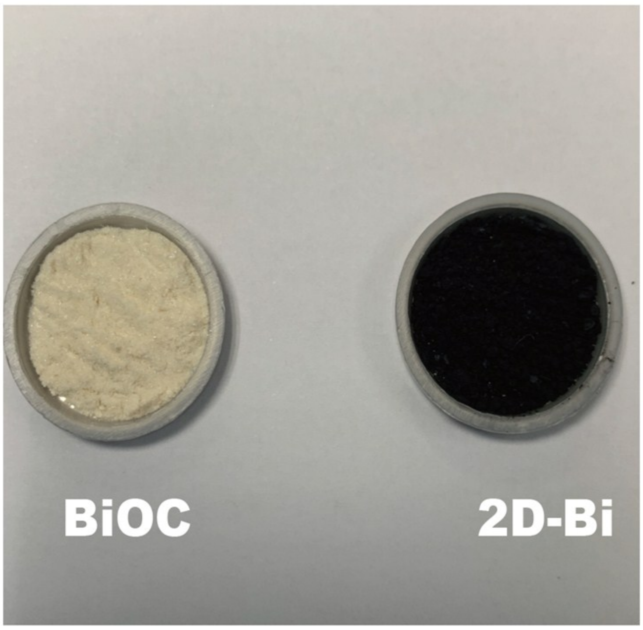

Figure S5. Photograph of BiOC and reduced 2D-Bi

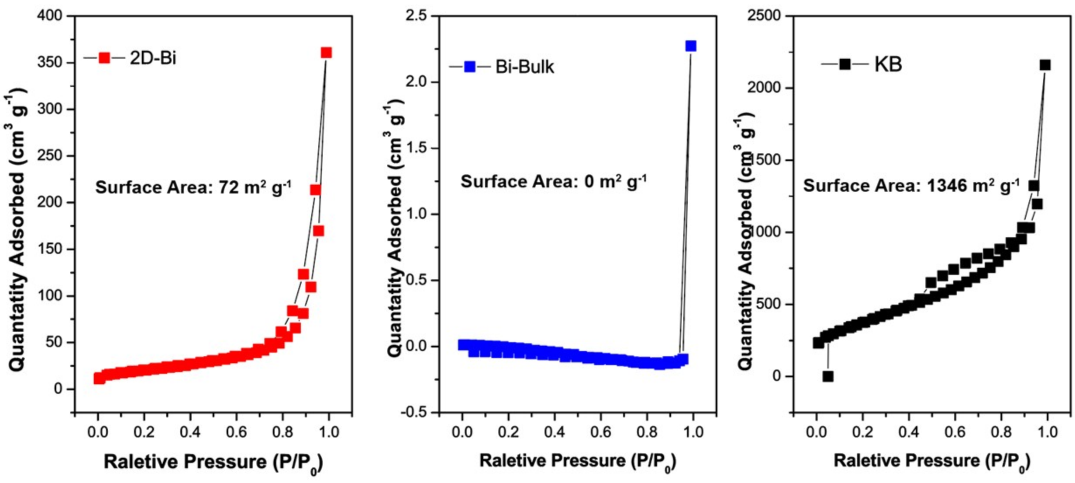

Figure S6. N_2 adsorption/desorption isotherm at 77K of 2D-Bi, Bi bulk, and KB.

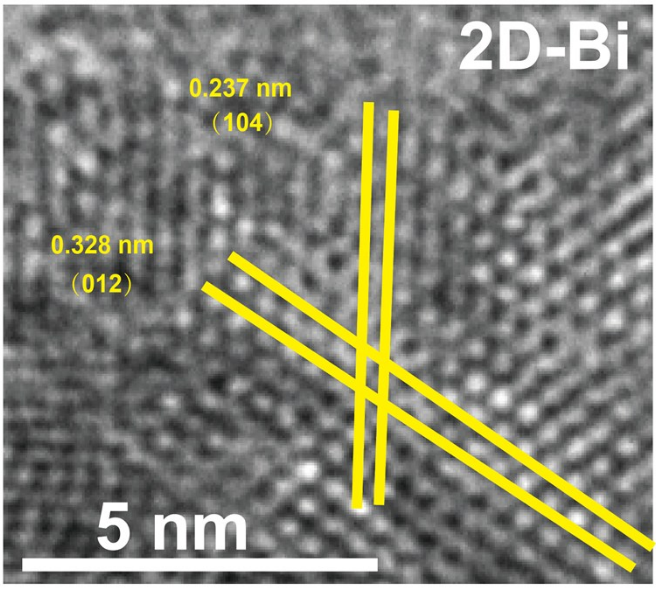

Figure S7. HRTEM image of a selected area in panel.

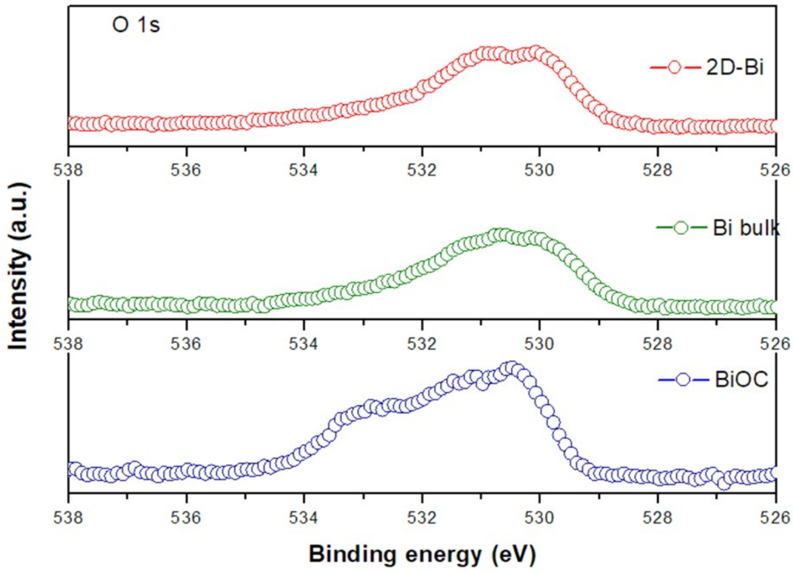

Figure S8. XPS spectra of O 1s for 2D-Bi, Bi bulk and BiOC. The peak at 531 eV could be ascribed to the adsorbed oxygen.

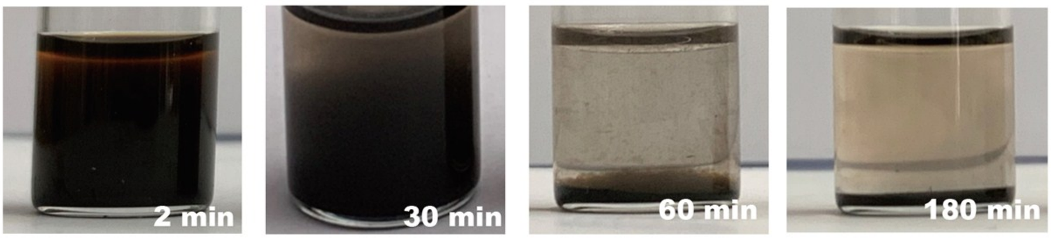

Figure S9. Photograph showing the adsorption ability of 2D-Bi in Li_2S_6 solution with increased concentration.

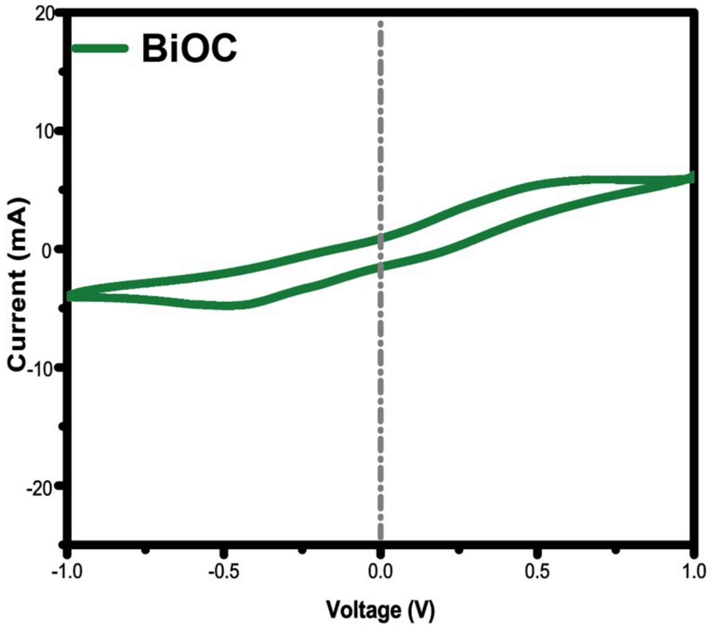

Figure S10. Cyclic coltammograms of the symmetric cell (BiOC as the working and counter electrodes, Li_2S_6 was added as the active material).

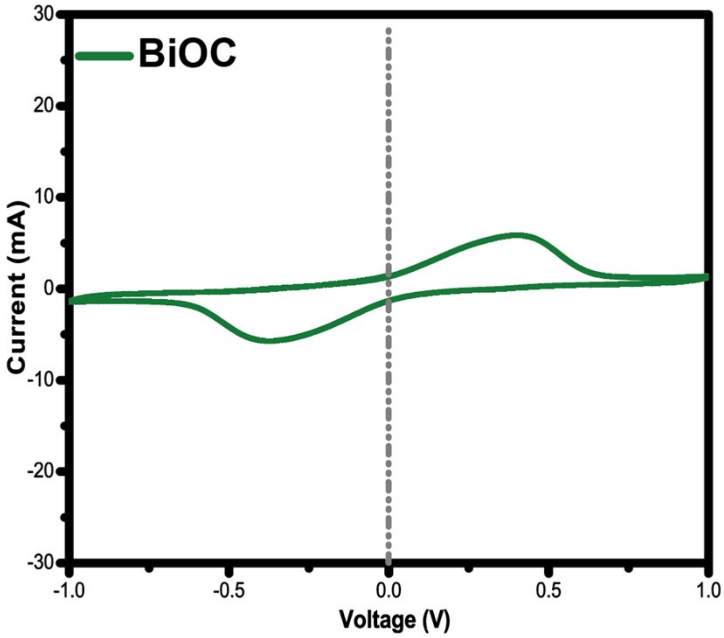

Figure S11. Cyclic voltammograms of the asymmetric cell (BiOC as the working and Li_2S/BiOC as the counter electrodes, Li_2S_6 was added at the working electrode part).

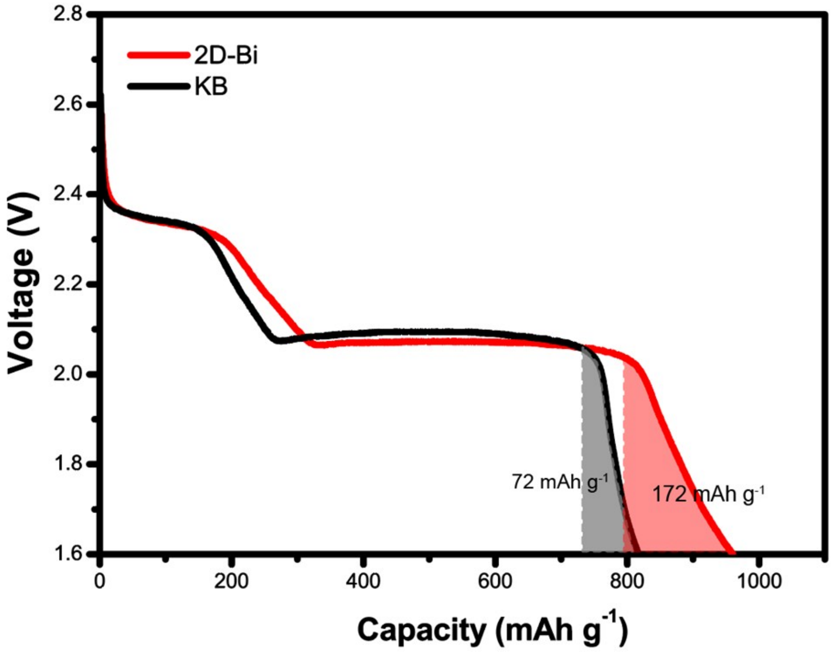

Figure S12. Galvanostatic discharge profiles of Li-S cells with 2D-Bi and KB modified separators. The shadowed part shows the capacity contribution from 2.0 to 1.6 V.

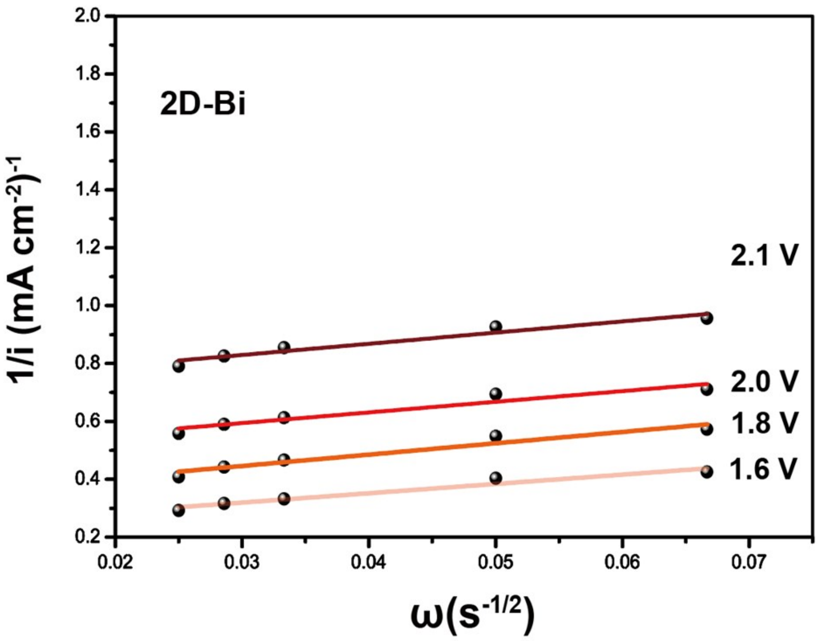

Figure S13. Levich−Koutecky plots derived from the negative-going scan from 2.3 to 1.5V on 2D-Bi electrode.

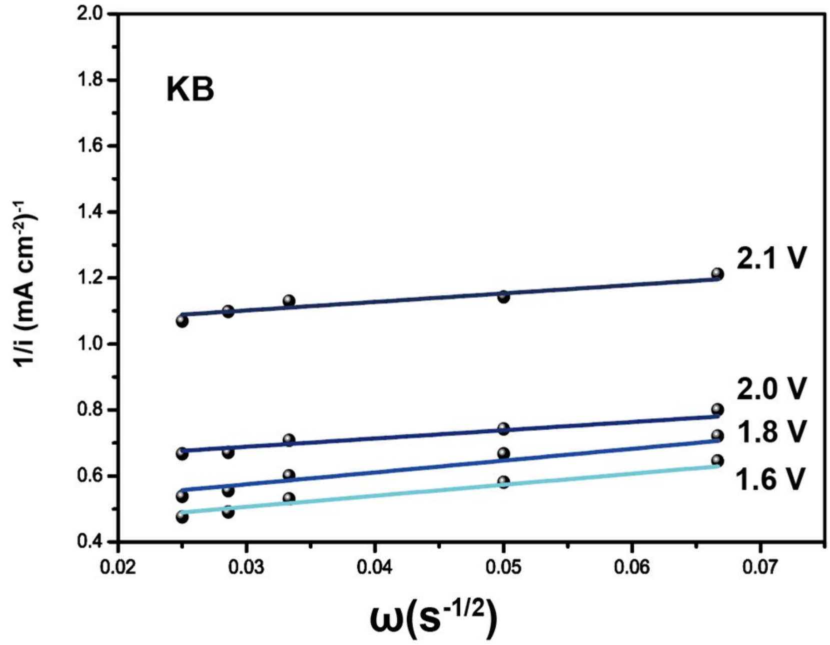

Figure S14. Levich−Koutecky plots derived from the negative-going scan from 2.3 to 1.5V on KB electrode.

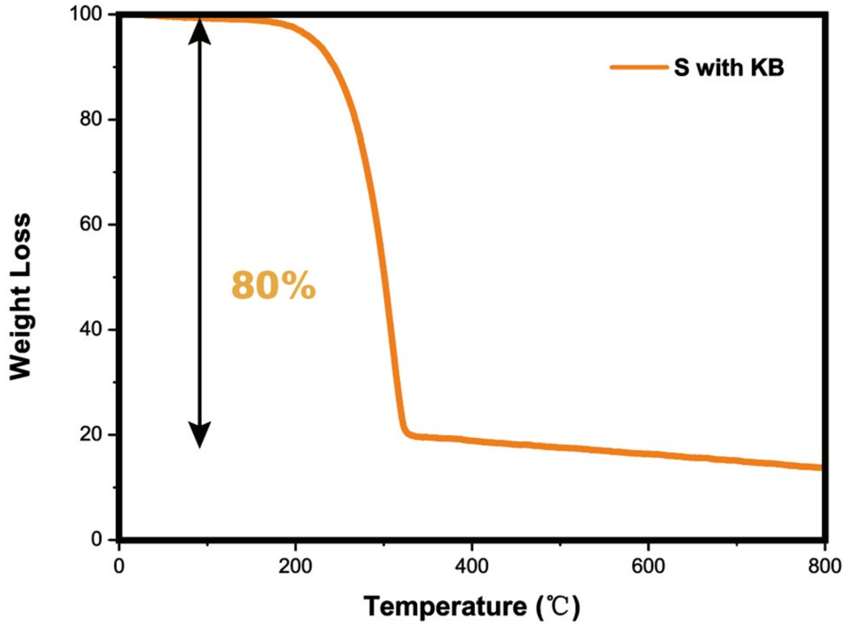

Figure S15. TGA curves of S and KB mixture which was directly used as cathode.

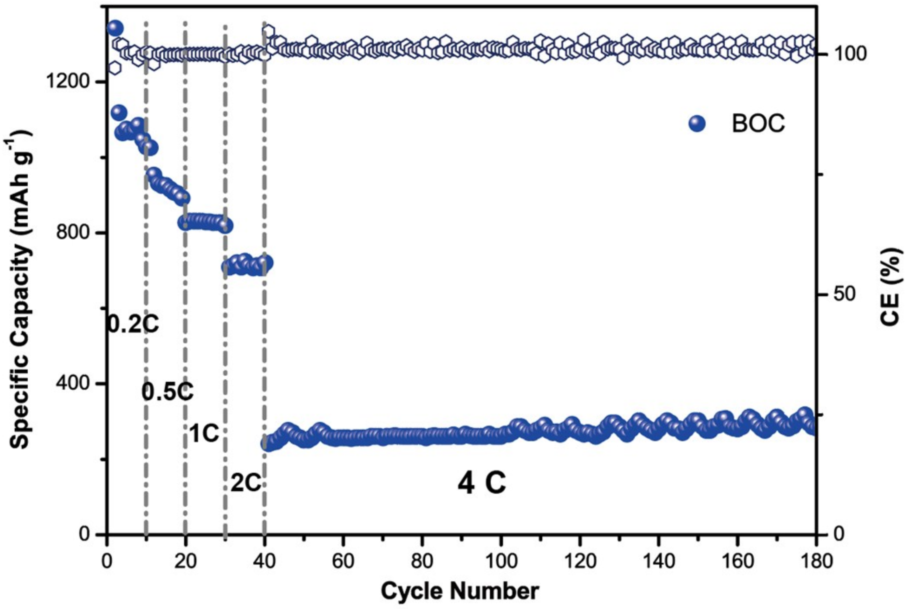

Figure S16. Rate cycling performance of BiOC.

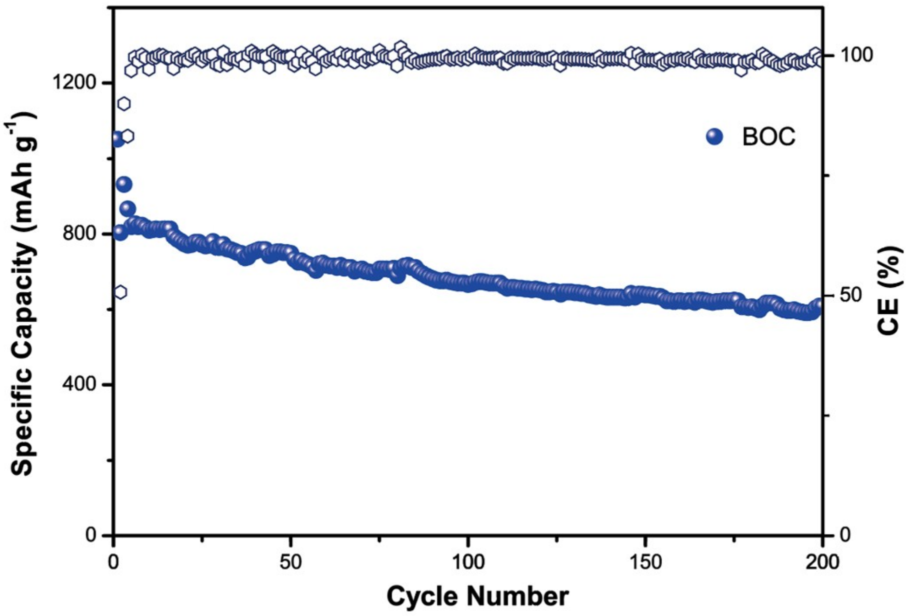

Figure S17. Cycling performance of BiOC at 0.5 C (S mass loading is ~1.5 mg).

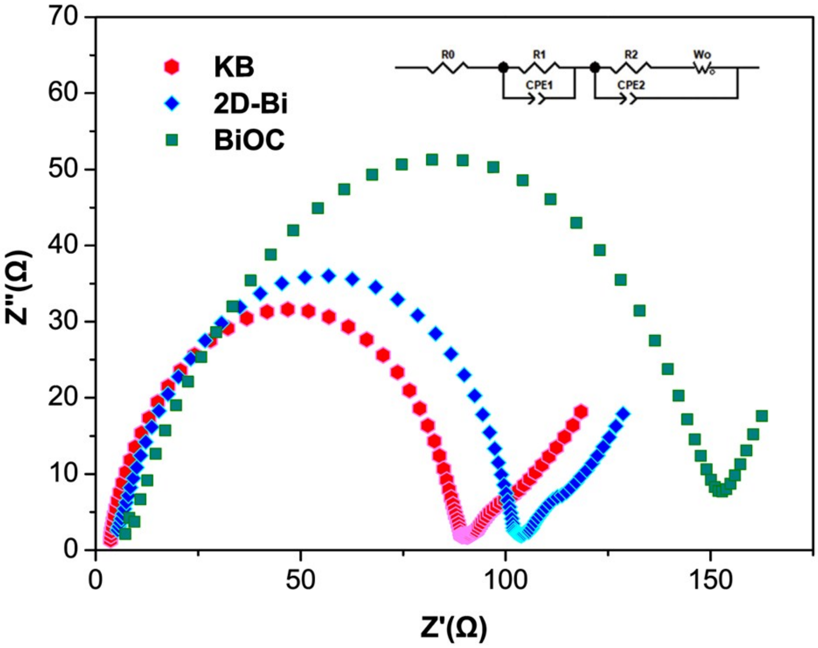

Figure S18. EIS spectra of KB, 2D-Bi and BiOC with KB.

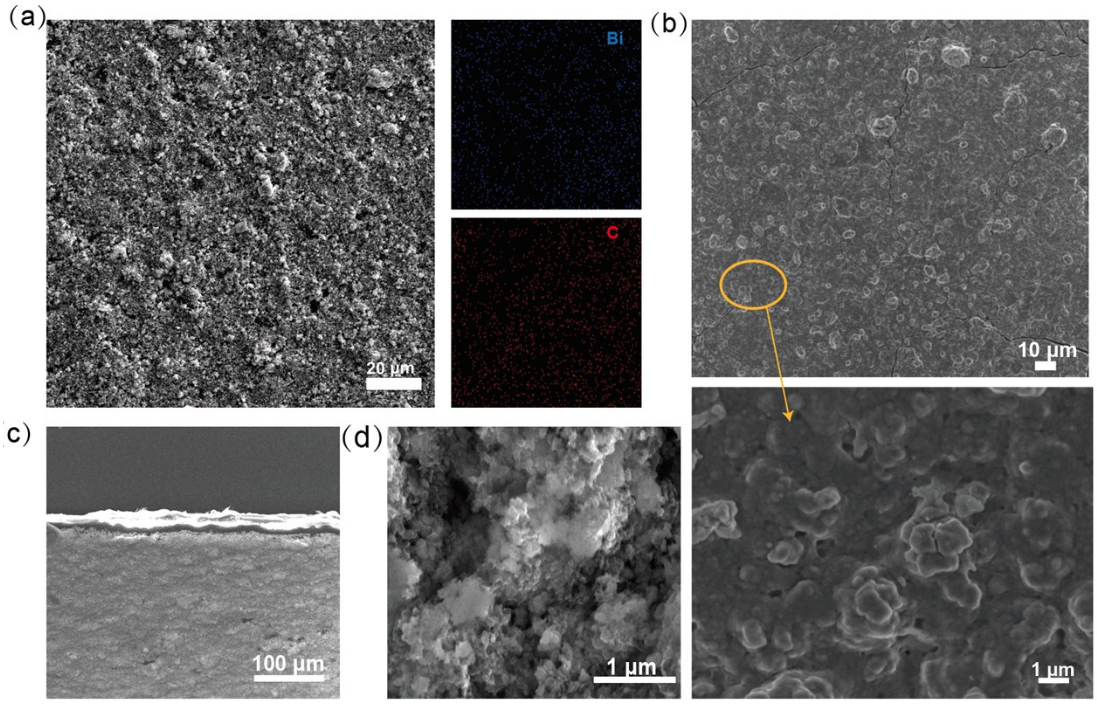

Figure S19. SEM images of modified separator after 200 cycles a, b) Top view of 2D-Bi modified separator with corresponding elemental mapping. c, d) Side view of 2D-Bi modified separator

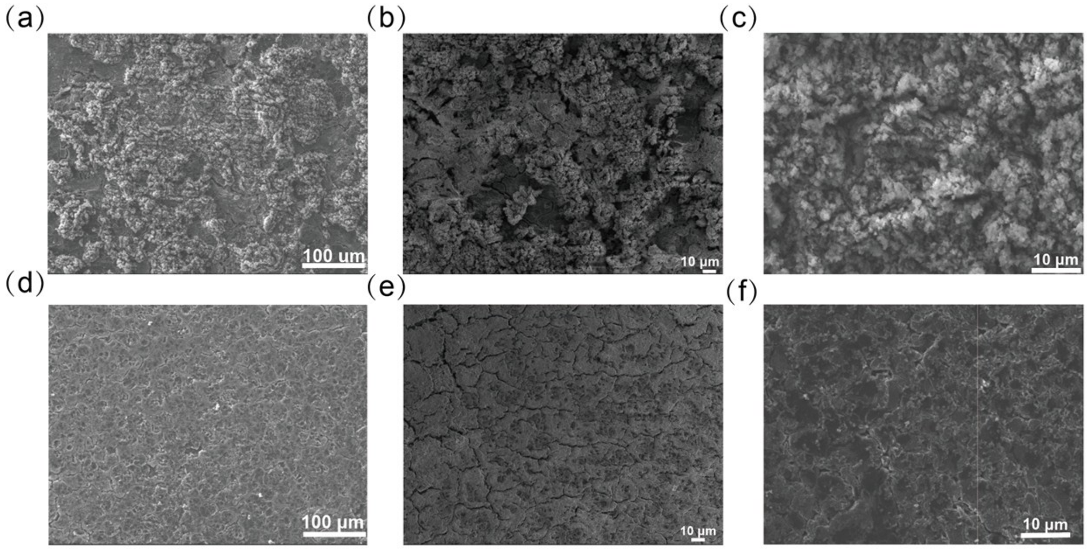

Figure S20. SEM images of Li anode after 100 cycles at 4 C. a, b, c) Li anode separated from normal Li-S cell. d, e, f) Li anode separated from 2D-Bi modified Li-S cell.

Table S1. The slops of KB and 2D-Bi derived from the fitted Levich−Koutecky plots.

Slop	KB	2D-Bi
Slop at 2.1V	2.57501	1.63329
Slop at 2.0V	2.50721	1.91772
Slop at 1.9V	3.15084	2.28293
Slop at 1.8V	3.58824	2.04357
Slop at 1.7V	3.37147	1.79006
Slop at 1.6V	3.33799	1.80209

Table S2. The intercepts of KB and 2D-Bi derived from the fitted Levich−Koutecky plots.

Intercept	KB	2D-Bi
Intercept at 2.1V	1.02426	0.79533
Intercept at 2.0V	0.66667	0.5484
Intercept at 1.9V	0.51773	0.47152
Intercept at 1.8V	0.53763	0.3972
Intercept at 1.7V	0.45074	0.32557
Intercept at 1.6V	0.40624	0.27504

Table S3. Comparison of electrochemical performance of this work with previous excellent works involving new Catalysts in Li-S batteries.

Catalyst	Sulfur content (%) & loading (mg cm^{-2})	Rate (1C=1675 mAh g^{-1})	Cycle number	Capacity retention (mAh g^{-1}%)	Reference
2D-Bi	80% & 1.5	0.5C	200	853-78.1%	This work
MoS_2	65% & N/A	0.5C	600	401-49.6%	[1]
Ti_3C_2	49% & 0.7-1	0.5C	50	899-68%	[2]
Nb_2O_5	60% & 1.5	0.5C	200	913-70%	[3]
S_6^{2-}-VPP	87% & 1	0.2C	300	840-75.3%	[4]
ZnS	70% & 1.4	0.2C	200	896-75%	[5]
SWCN	80% & 3	0.2C	300	501-44%	[6]
HEMO-1	50% & 1.2	0.1C	200	664-55%	[7]
SnO_2	55% & 2.8	1C	200	734-74%	[8]

Table S4. Comparison of high rate electrochemical performance of this work with previous excellent works involving new Catalysts in Li-S batteries.

Catalyst	0.2C (mAh g^{-1})	0.5C (mAh g^{-1})	1C (mAh g^{-1})	2C (mAh g^{-1})	4C or 5C (mAh g^{-1})	Cycling Performance at high rate	Reference
2D-Bi	1305	1090	930	830	710	65% (500 cycles,408 mAh g^{-1}, 10C)	This work
HNO	N/A	N/A	790	731	685(5C)	85% (250 cycles,5C)	[9]
FeP	1105	910	594	N/A	400	71% (200 cycles, 1C)	[10]

Co/N-PCNSs	1203	871	777	683	549(5C)	86% (411 mAh g^{-1},400 cycles, 5C)	[11]
Co-Fe-P	1118	1012	863	741	N/A	71.8% (620 mAh g^{-1},500 cycles, 1C)	[12]
Co/mSiO2	1193	1075	1012	915	552(5C)	77% (774 mAh g^{-1},250 cycles, 1C)	[13]
VN	1280	1043	899	760	N/A	41.7% (400 mAh g^{-1},400 cycles, 1C)	[14]
S/N-CNTs/Co-NFs	1140	986	847	684 (3C)	N/A	60.8% (623 mAh g^{-1},500 cycles, 1C)	[15]
MoSe@rGO	1275	1123	988	863	n/a	49.7% (672 mAh g^{-1},500 cycles, 2C)	[16]

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