Supporting Information

Phase Separation in MOF: One Effective Route to Construct Core-shell FeS@Carbon Nanocomposite Encapsulated in Three-Dimensional Graphene as Flexible High-Performance Anode for Sodium-Ion Battery

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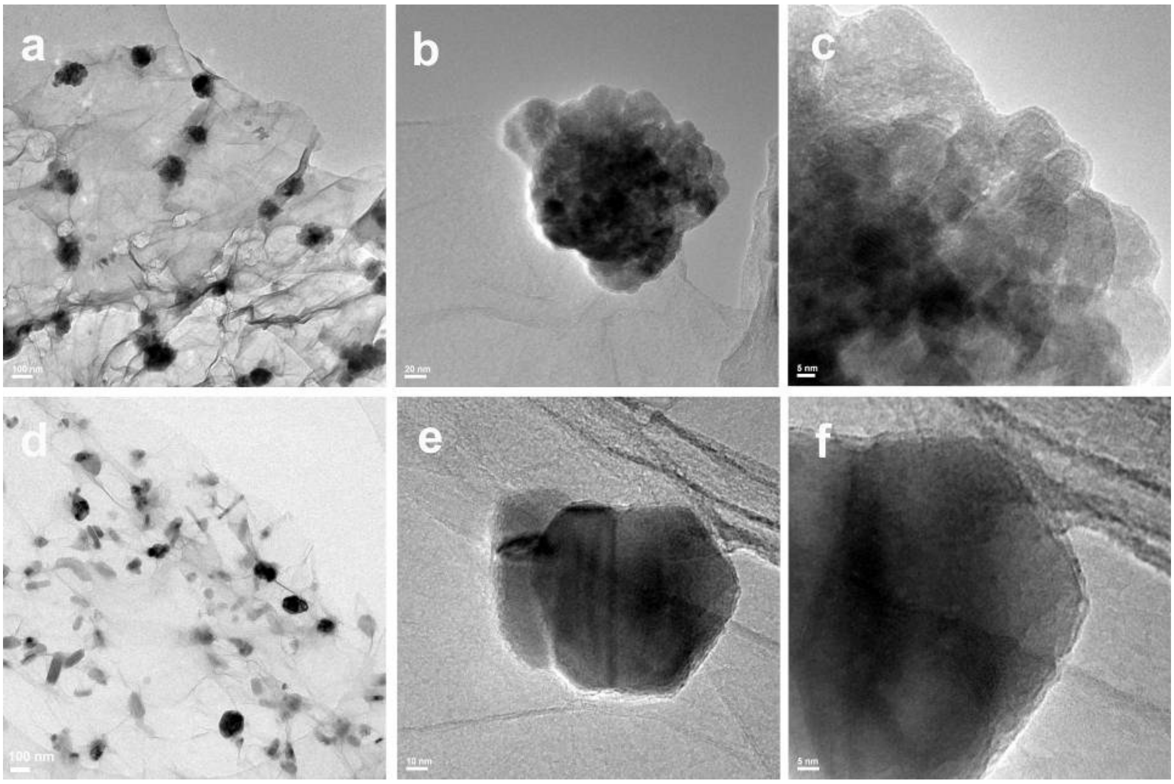

Figure S1. (a-c) TEM images of 3DG/FeS@C obtained at 400 °C; (d-f) TEM images of 3DG/FeS@C obtained at 600 °C.

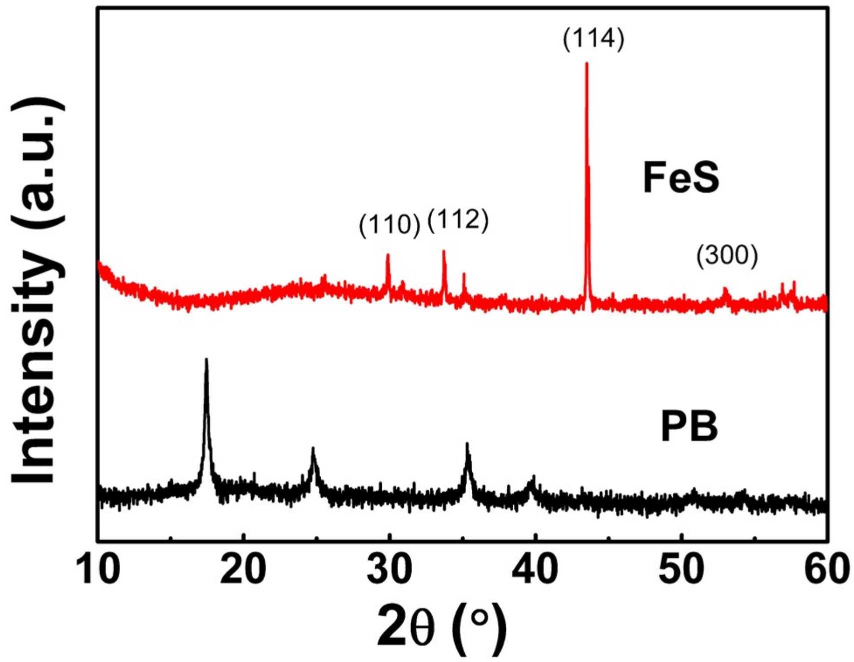

Figure S2. XRD patterns of neat PB and FeS.

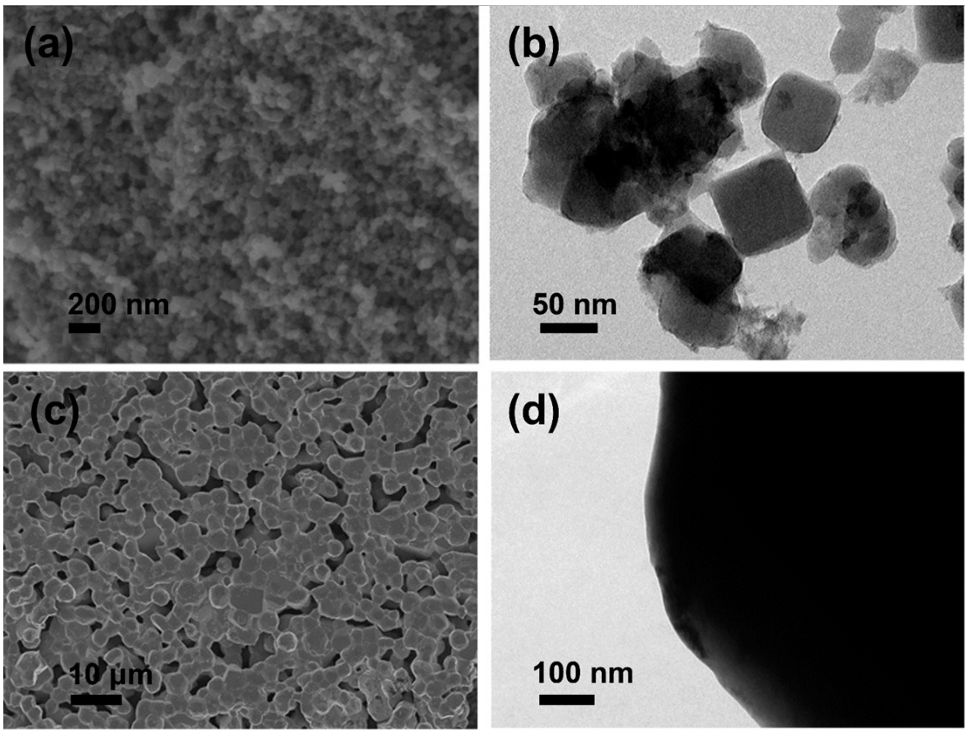

Figure S3. (a) SEM and (b) TEM images of pure PB nanoparticles; (c) SEM and (d) TEM images of FeS micro-sized particles.

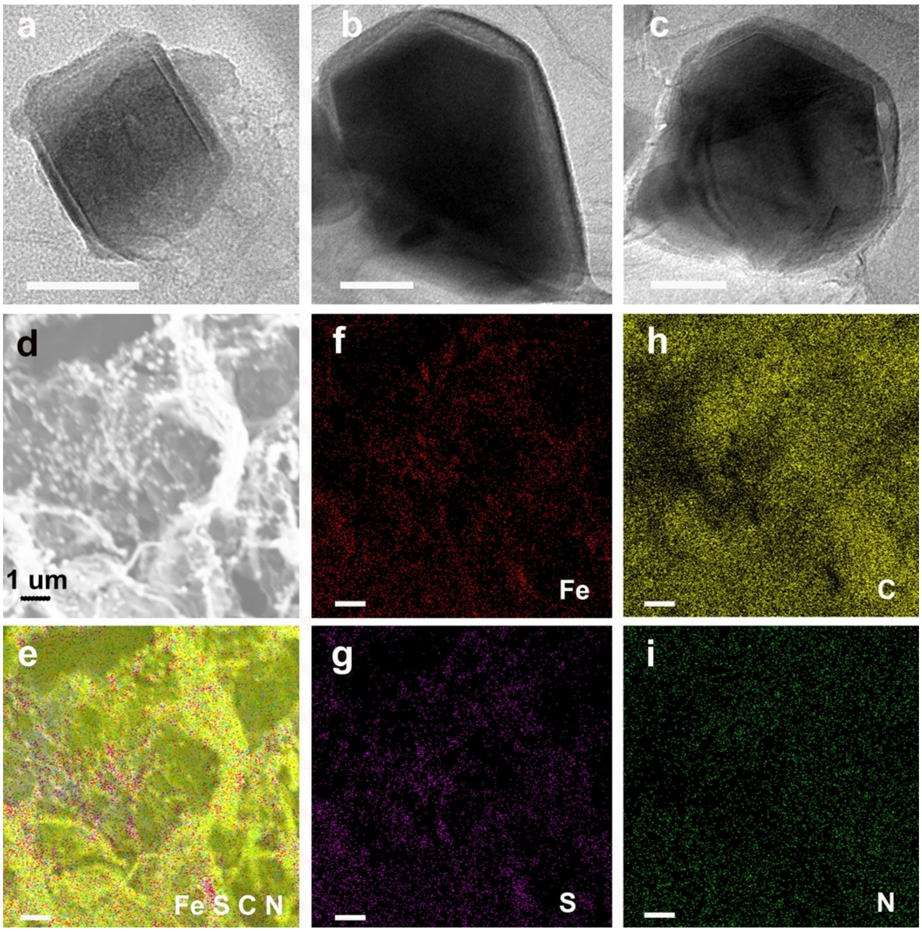

Figure S4. (a-c) Light-field TEM images of several FeS@C nanocomposites on 3DG. The scale bar is 50 nm. (d) SEM image of 3DG/FeS@C and corresponding Elemental mapping pictures of (e) Fe-S-C-N, (f) Fe, (g) S, (h) C and (i) N. The scale bar is 1um.

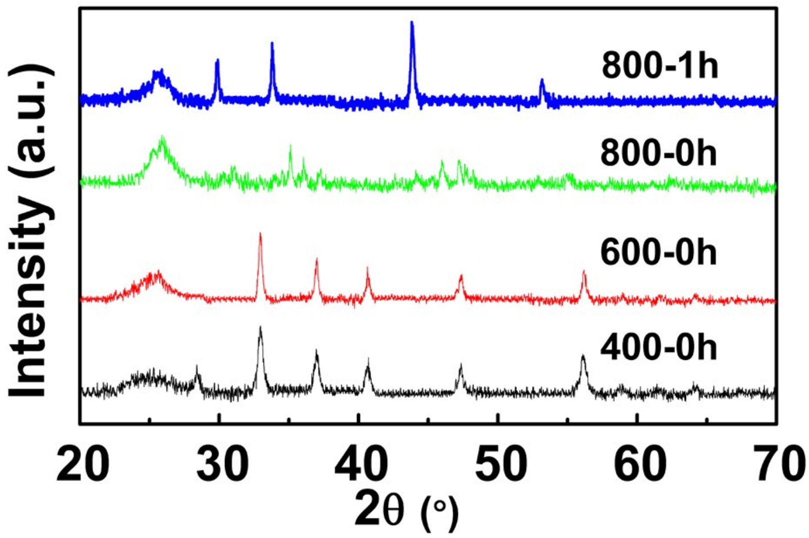

Figure S5. XRD patterns of the obtained products collected at different reaction temperature for different reaction time, (a) 400 °C 0 h, (b) 600 °C 0 h, (c) 800 °C 0 h, (d) 800 °C 1 h.

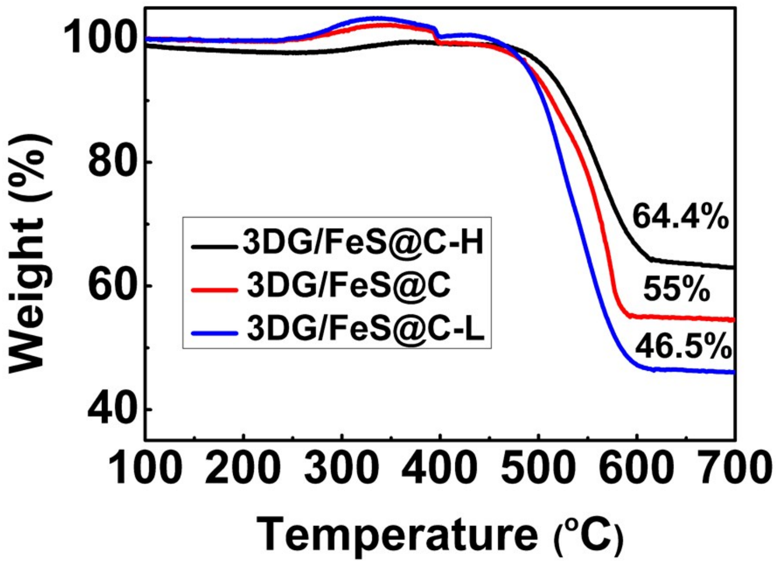

Figure S6. TGA curves of 3DG/FeS@C-H, 3DG/FeS@C, and 3DG/FeS@C-L at 10 °C /min in air flow.

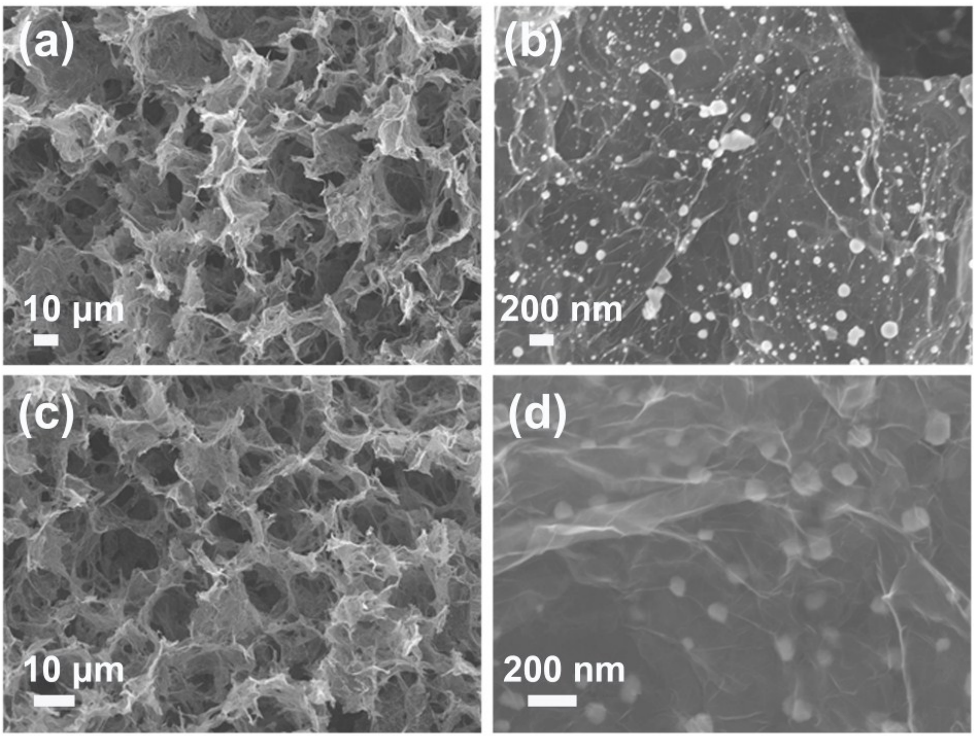

Figure S7. SEM images of 3DG/FeS@C-H (a, b) and 3DG/FeS@C-L (c, d).

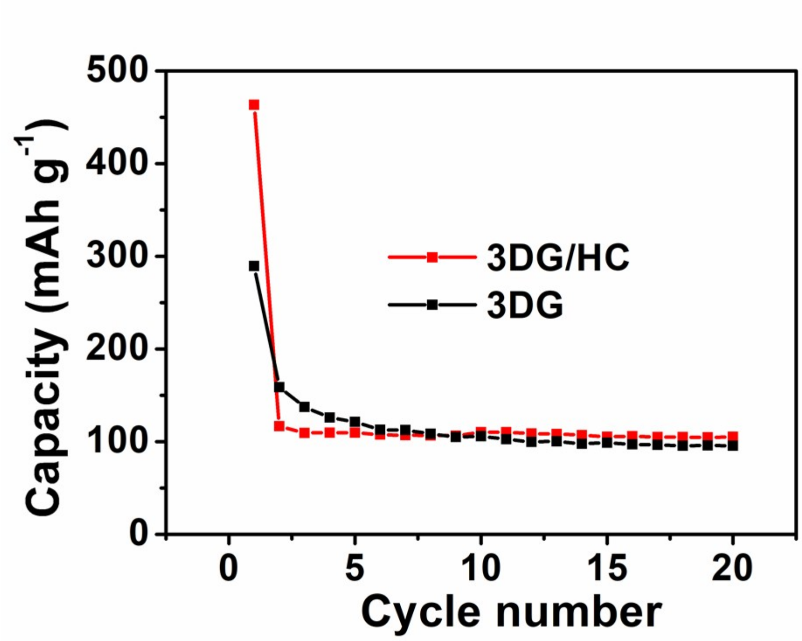

Figure S8. Cycling performance of 3DG/HC obtained by chemical etching of 3DG/FeS@C and 3DG at 0.1 A/g.

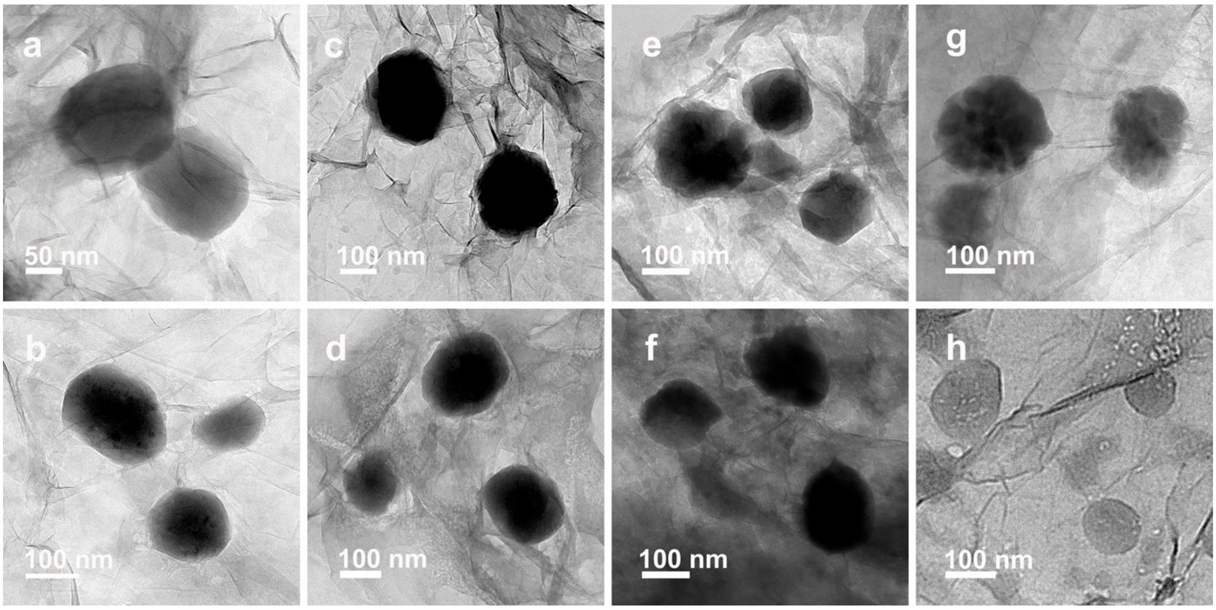

Figure S9. TEM pictures of 3DG/FeS@C after different discharge/charge cycles: (a) 1st discharge, (b) 1st charge, (a) 10th discharge, (b) 10th charge, (a) 40th discharge, (b) 40th charge, (a) 80th discharge, (b) 80th charge.

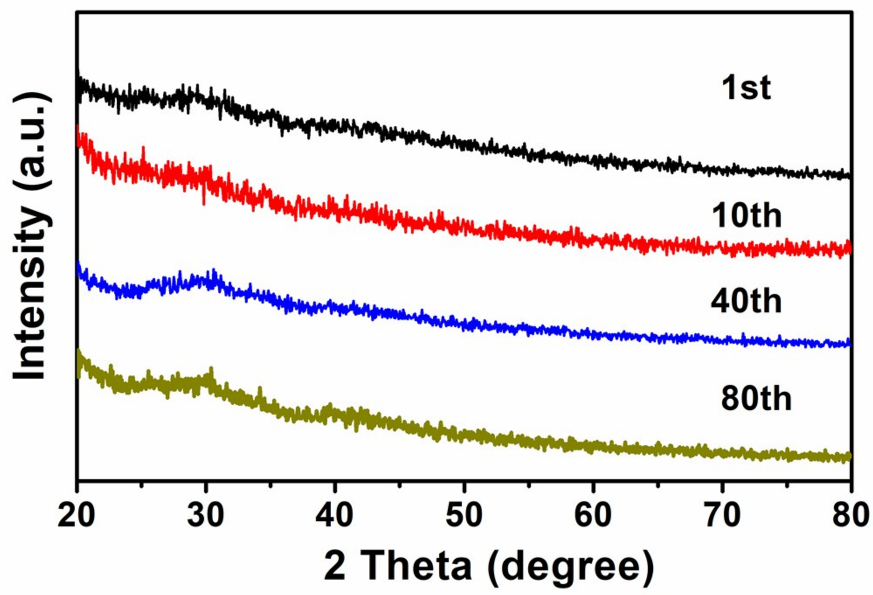

Figure S10. XRD pictures of 3DG/FeS@C at different discharge cycles.

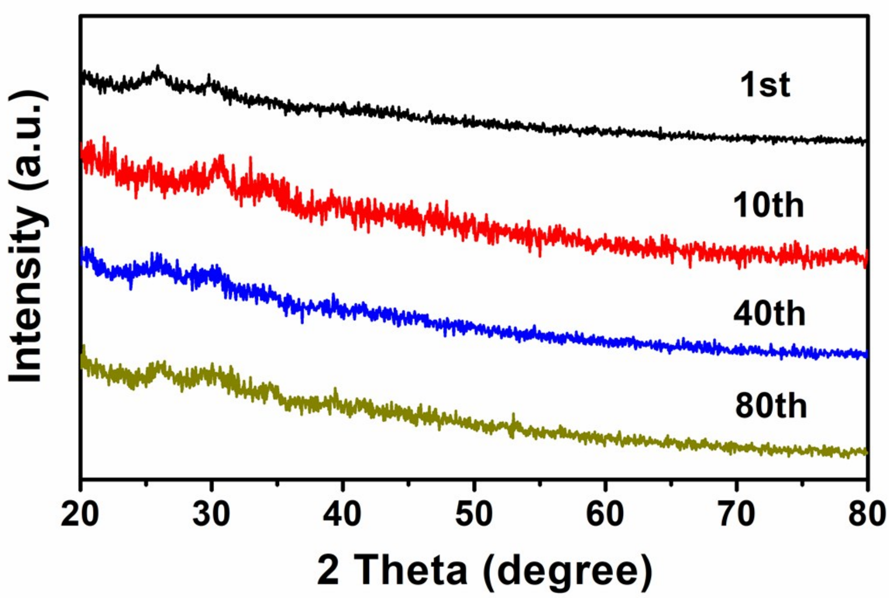

Figure S11. XRD pictures of 3DG/FeS@C at different charge cycles.

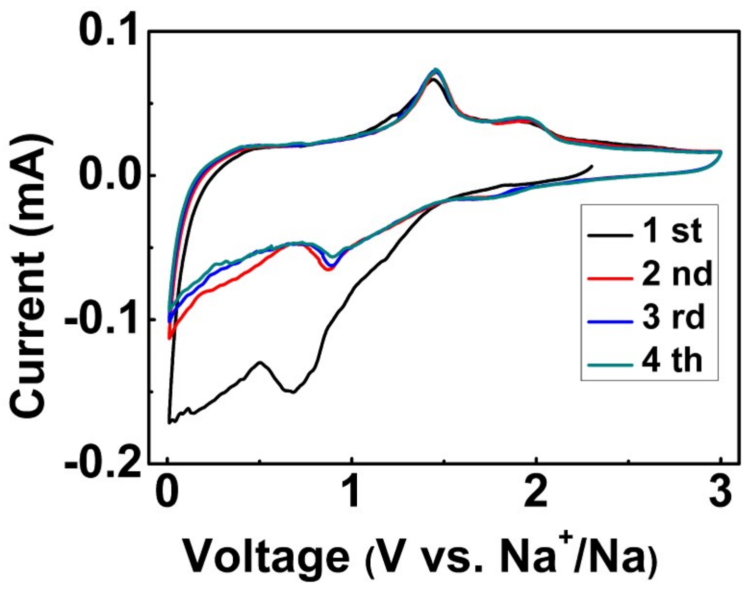

Figure S12. CV profiles of 3DG/FeS@C at a scan rate of 0.1 mV s^{-1}.

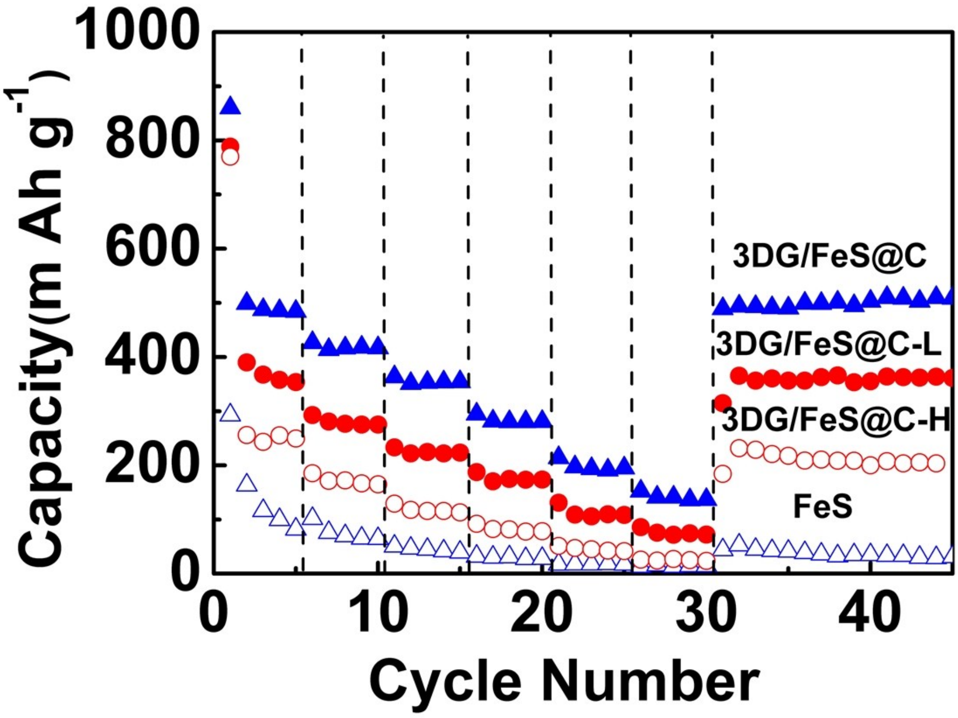

Figure S13. Rate performance of 3DG/FeS@C, 3DG/FeS@C -L, 3DG/FeS@C -H, and FeS.

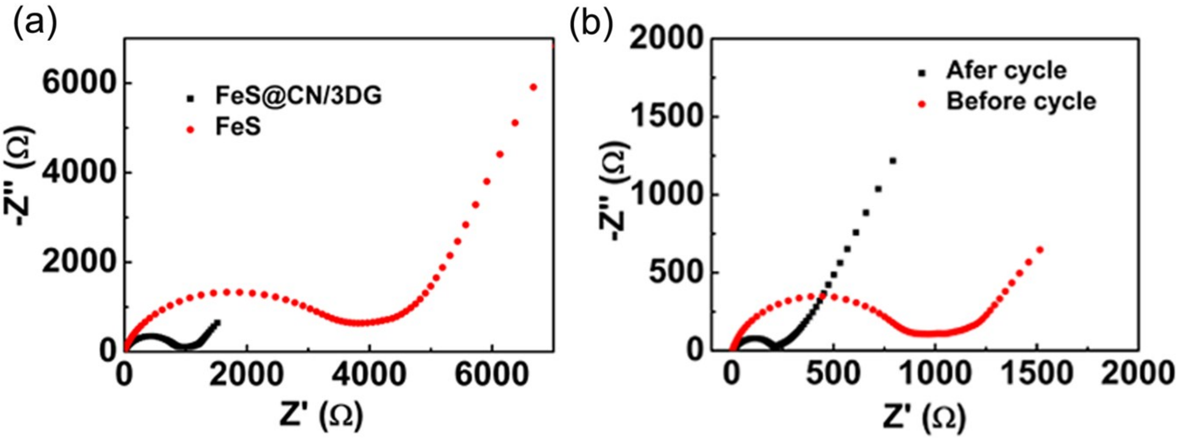

Figure S14. EIS plots of 3DG/FeS@C and FeS before cycle (a), and 3DG/FeS@C before and after cycle test (b).

Table S1. Comparison of electrochemical performance of 3DG/FeS@C and recently reported typical MS-based anode materials.

Materials, structure	Ratio of active materials	Area mass loading (mg/cm²)	Current density (mA/g)	Capacity (mAh/g)/ after cycles	High current density (mA/g)	Capacity (mAh/g)/ after cycles	Capacity Retention (Cycles)	Ref.
FeS / CA	80%	N.A.	100	410 / 60 328 **(by electrode)**	500	280 / 200 224 **(by electrode)**	N.A.	*Angew. Chem. Int.Ed. 2016,55, 15925*
Core shell FeS / C	80%	~1.5-2.0	100	488 / 300 390 **(by electrode)**	1000	368 / 500 294.4 **(by electrode)**	N.A.	*Nat. Commun. 2015,6, 8689*
FeS@C on Carbon Cloth	100%	N.A.	91.3	430 / 50 **(by electrode)**	730	150 / 200 **(by electrode)**	N.A.	*ACS Appl. Mater. Interfaces 2015, 7, 27804*
FeS-rGO	70%	0.5	1000	547 / 50 383 **(by electrode)**	6000	340 / 50 238 **(by electrode)**	N.A.	*Chem. Eur.J. 2016, 22,2769*
FeS@C-N	70%	1.0	100	345 / 500 242 **(by electrode)**	800	365.4 / 15 256 **(by electrode)**	N.A.	*J. Alloys and Compounds 2016, 688, 790*
Co9S8–carbon	70%	N.A.	100	511 / 10 358 **(by electrode)**	500	404 / 50 283 **(by electrode)**	80%	*CARBON 2015, 94, 85*
CoS-rGO	80%	1.0	100	636 / 10 509 **(by electrode)**	1000	420 / 1000 336 **(by electrode)**	88%	*small 2016, 12, 1359*
CNT / CoS	80%	2.0	100	470 / 100 376 **(by electrode)**	500	398 / 200 318 **(by electrode)**	90%	*J. Power Sources 2017, 339, 41*
CoS2	80%	~1.3	100	728 / 30 582 **(by electrode)**	1000	690 / 100 552 **(by electrode)**	N.A.	*Nano Res. 2016, 9, 198*
Core−shell	70%	1.4	200	453 / 10	500	396 / 100	86%	*ACS Appl.*

SnS−MoS2				317 **(by electrode)**		277 **(by electrode)**		*Mater. Interfaces 2015, 7, 24694*
VS / rGO	70%	1.2-1.5	100	240.8 / 100 168 **(by electrode)**	800	192.1 / 15 134 **(by electrode)**	N.A.	*ACS Appl. Mater. Interfaces 2015, 7, 20902*
Sb2S3@C	70%	N.A.	100	699.1 / 100 489 **(by electrode)**	3200	368 / 500 294.4 **(by electrode)**	N.A.	*ACS Appl. Mater. Interfaces 2015, 7, 19362*
ZnS-Sb2S3@C Core-Double Shell	70%	N.A.	100	630 / 120 441 **(by electrode)**	800	390.6 / 30 273 **(by electrode)**	N.A.	*ACS Nano. 2017, 11, 6474*
single-layered MoS2/carbon	70%	N.A.	100	854 / 5 598 **(by electrode)**	1000	484 / 100 339 **(by electrode)**	69.1%	*Angew. Chem. Int. Ed. 2014, 53, 2152*
FeS2@C core–shell nanoboxes	70%	1.2	100	511 / 100 358 **(by electrode)**	2000	330 / 800 231 **(by electrode)**	N.A.	*Energy Environ. Sci.2017. 10, 1576*
PBCS	80%	1.0-1.5	50	500 / 5 400 **(by electrode)**	500	87 / 150 70 **(by electrode)**	24.1%	*Adv. Energy Mater. 2017, 1700180*
FeS@C	**100%**	**~2.0**	**100**	**734.5 / 130** **(by electrode)**	**1000**	**358 / 300** **(by electrode)**	**97.9%**	***This work***

Note: In typical metal sulfide-based electrodes reported previously, polymer binder and/or conductive carbon are used to mix with active material to prepare electrodes. It is more meaningful to normalize the capacity to the total mass of the entire electrode for practical application. Therefore, we specially list these capacity values (denoted as “by electrode”) for comparison.