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Electronic Supplementary Materials

A 3D nanostructure of graphene interconnected with hollow carbon spheres for high performance lithium-sulfur batteries

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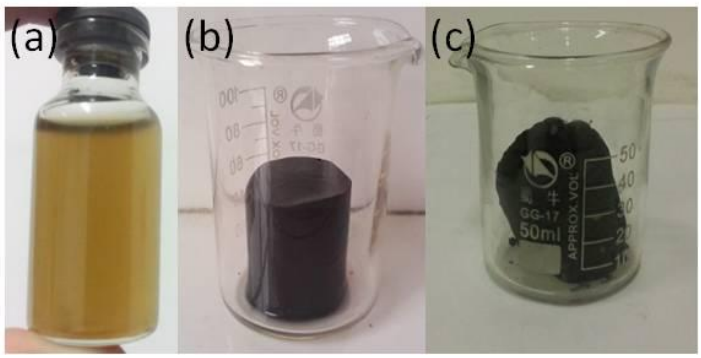

Figure S1 optical photographs of the (a) GO solution, (b) 3D GO-RF@SiO_2 wet gel, and (c) rGO-RF@SiO_2 gel

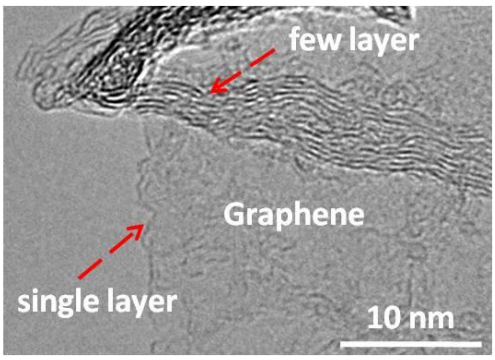

Figure S2 selected high resolution TEM image of the 3D rGO-HCS nanocomposite.

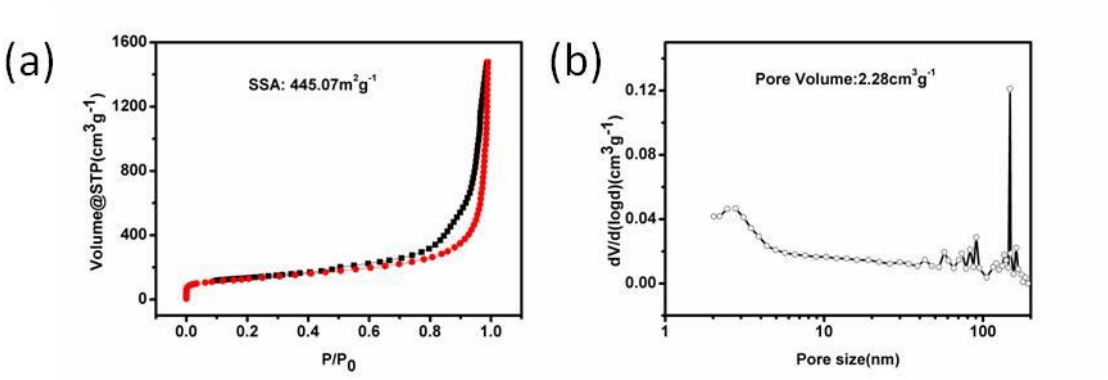

Figure S3 N_2 adsorption isotherms and pore-size distribution of 3D rGO-HCS nanocomposite.

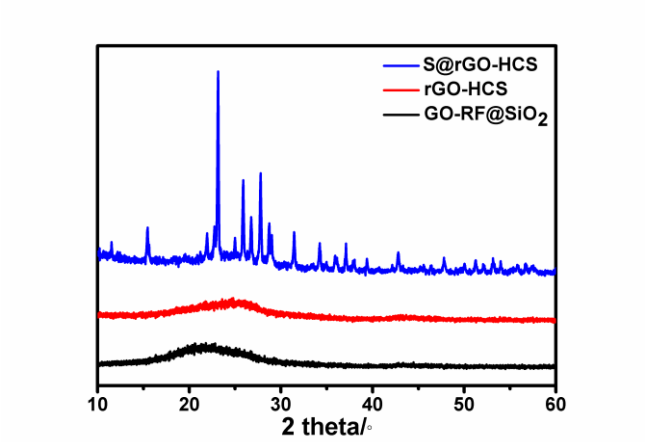

Figure S4 XRD patterns of 3D GO-RF@SiO_2,3D rGO-HCS and the S@rGO-HCS nanocomposite

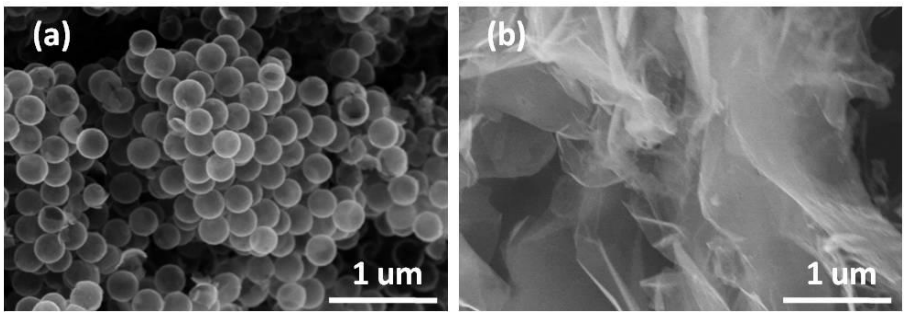

Figure S5 SEM images of (a) S@ HCS and (b) S@G nanocomposite

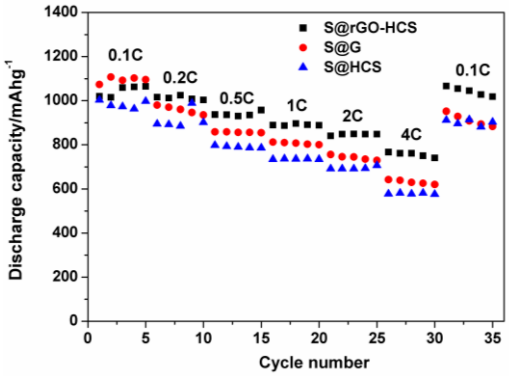

Figure S6 Rate performance of the S@rGO-HCS, S@HCS, and S@G electrode

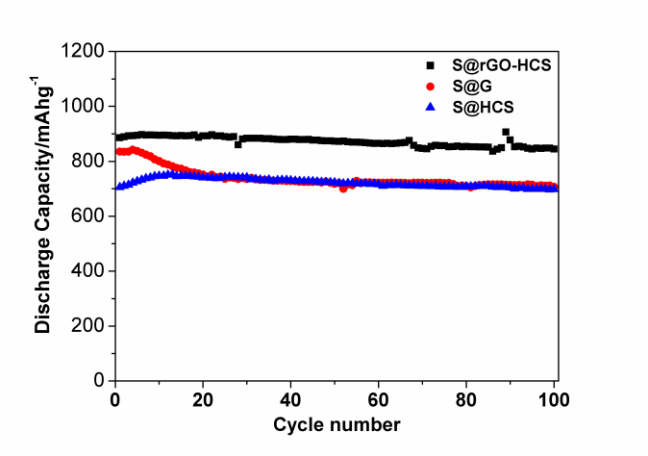

Figure S7 Cycling performance of the S@rGO-HCS, S@HCS, and S@G electrode at 1C rate

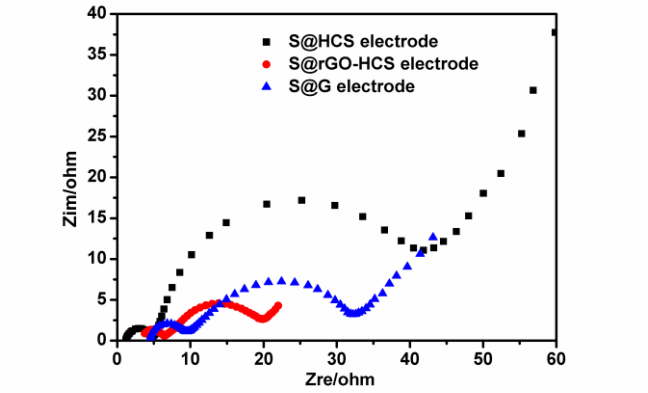

Figure S8 Nyquist plots for the S@rGO-HCS, S@HCS and S@G electrodes in the frequency range of 100 mHz to 100 kHz

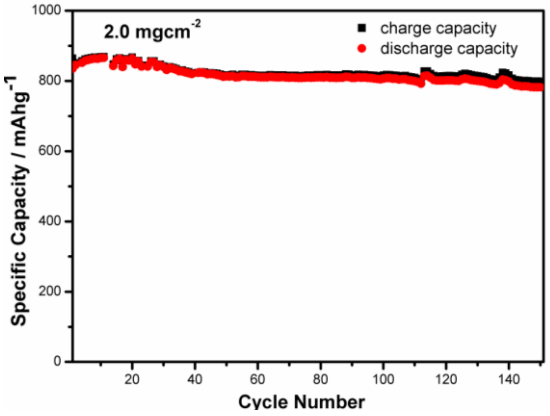

Figure S8 Cycling performance of the S@rGO-HCS electrode with sulfur mass loading of 2.0 mg cm^{-2} at 0.5C rate

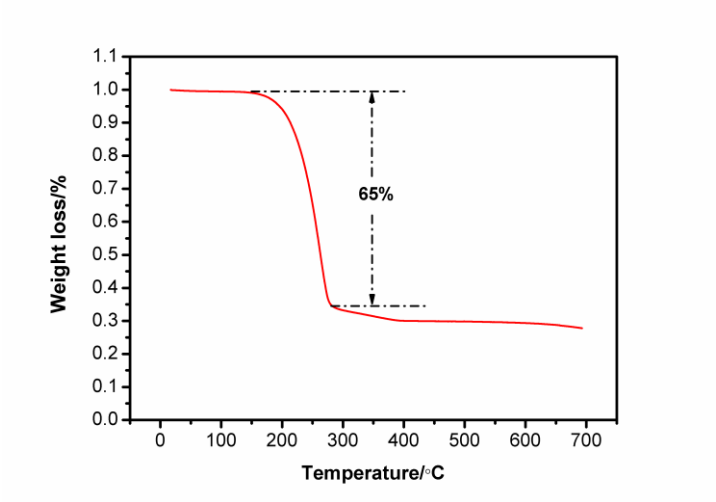

Figure S9 Thermogravimetric analysis of the S@rGO-HCS nanocomposite, which were carried out at a flow rate of 10℃/min under N_2 flow

Table S1. Comparisons of comprehensive performance between this work and some hollow sphere or graphene based sulfur cathode materials reported in recent years.

Composite [ref.]	Sulfur content	Potential Range [V]	Discharge Capacity [$mAhg^{-1}$]	Cyclic capacity retention	Rate parameter [$mAhg^{-1}$]
C@S[46]	69.7%	1.7~3.1	1071,0.5C	91%,100th	450,3C
p-PCNS-H[49]	70%	1.5~3.0	920,0.5C	89.4%,100th	875,1C
DHCS-S[47]	64%	1.5~3.0	~1000,0.5C	69%,100th	350,1C
HCS-S[52]	57%	1.7~2.8	1098,0.12C	77%,100th	——
CarbHS-G-S[48]	50%	1.1~3.2	1000,1C	60%,50th	400,5C
S−Pani york−shell[11]	58%	1.5~3.0	920 ,0.5C	~77%,100th 68.3%,200th	——
PPy⊃HCSs⊃S[51]	53.6%	1.2~3.0	~600,0.5C	——	~500,1C
PDA−NHC−S[50]	65%	1.5~2.9	740,0.6C	85.1%,600th	——
GES[34]	83.3%	1.5~3.0	915,0.75C	86%,160th	480,6C
3D-GNS[42]	87.6%	1.7~2.8	853,0.36C	92.8%,145th	743,0.9C
N-ACNT/G@S [38]	52.6%	1.6~3.0	1152,1C	76%,80th	770,5C
S@NG[37]	65.2%	1.7~2.8	1030,0.5C	81.5%,100th 73%,200th 69.3%,300th	606,5C
L-GPCS[53]	68%	1.7~2.6	885.5,0.5C	70%,100th	583,5C
S@SCNMM[54]	74%	1.0~3.0	1155,1C	75%,100th	860,5C
S@rGO-HCS (This work)	65%	1.7~2.8	972,0.5C	93.9%,100th 86.1%,200th 79.3%,300th 73.2%,400th	~770,4C