Supporting information

Understanding the Modulation Essence and Surface Chemistry in Heteroatom Incorporated Graphene-like Matrix Toward High-rate Lithium-Sulfur Batteries

Zhenxin Zhao[a,1], Zonglin Yi[b,c,1], Huijun Li[a], Rajesh Pathak[d], Xiaoqin Cheng[a], junliang Zhou,[a] Xiaomin Wang[a,*], Qiquan Qiao[d]

[a] *College of Materials Science and Engineering, Shanxi Key Laboratory of New Energy Materials and Devices, Taiyuan University of Technology, Taiyuan, 030024, PR China*

[b] *CAS Key Laboratory of Carbon Materials, Institute of Coal Chemistry, Chinese Academy of Sciences, Taiyuan, 030001, PR China*

[c] *University of Chinese Academy of Sciences, Beijing, 100049, PR China*

[d] *Mechanical & Aerospace Engineering, Syracuse University, Syracuse, NY 13244, USA*

[*]Corresponding author.

E-mail address: wangxiaomin@tyut.edu.cn

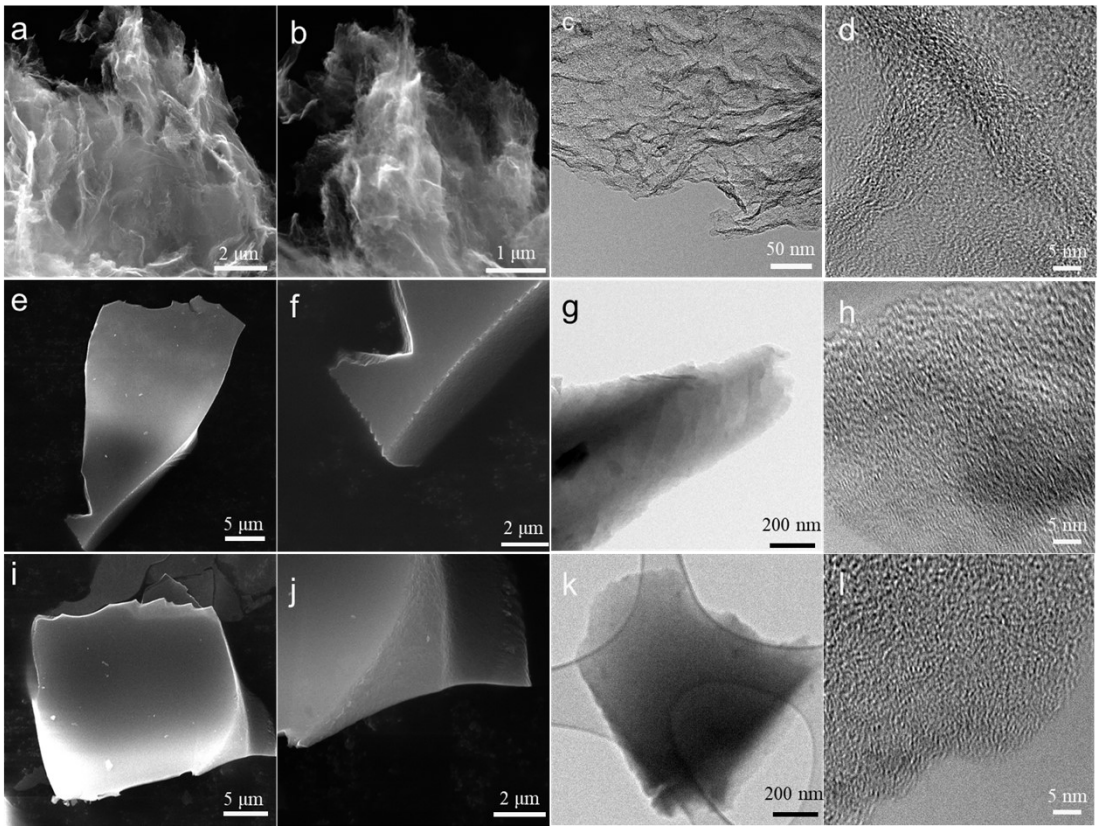

Fig. S1 SEM and TEM images of (a-d) NC, (e-f) PC, (i-l) GC

Table S1 D band and G band positions and integral area ratio

	D band (cm^{-1})	G band (cm^{-1})	I_D/I_G
C	1357	1593	1.17
PC	1348	1588	1.24
NC	1377	1592	1.28
NPC	1378	1588	1.56

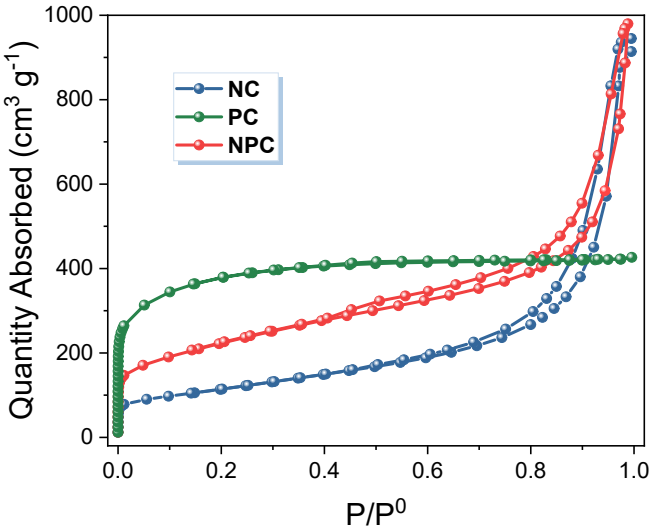

Fig. S2 N_2 adsorption and desorption isotherms

Table S2 The textural properties of HPC, Fe_3O_4/HPC, S/Fe_3O_4/HPC

Samples	S_{BET}[a] ($m^2\ g^{-1}$)	V_t[b] ($cm^3\ g^{-1}$)	$V_{<2\ nm}$[c] ($cm^3\ g^{-1}$)
NC	407	1.46	0.037
PC	1258	0.65	0.42
NPC	777	1.52	0.18

a The specific surface area was calculated by BET method.

b The total pore volume was obtained at relative pressure P/P^o=0.99.

c The pore volume based on different pore size range was calculated by DFT method.

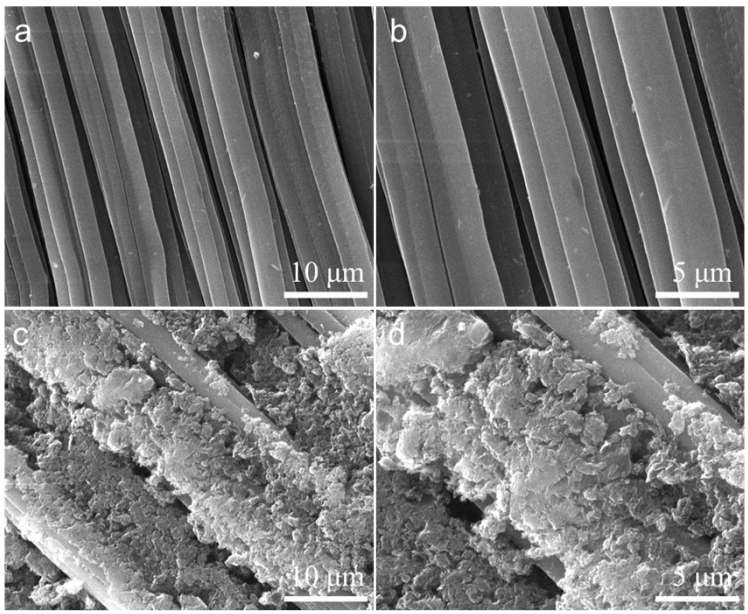

Fig. S3 SEM images of (a) pure carbon cloth and (b) the carbon cloth coated with slurries

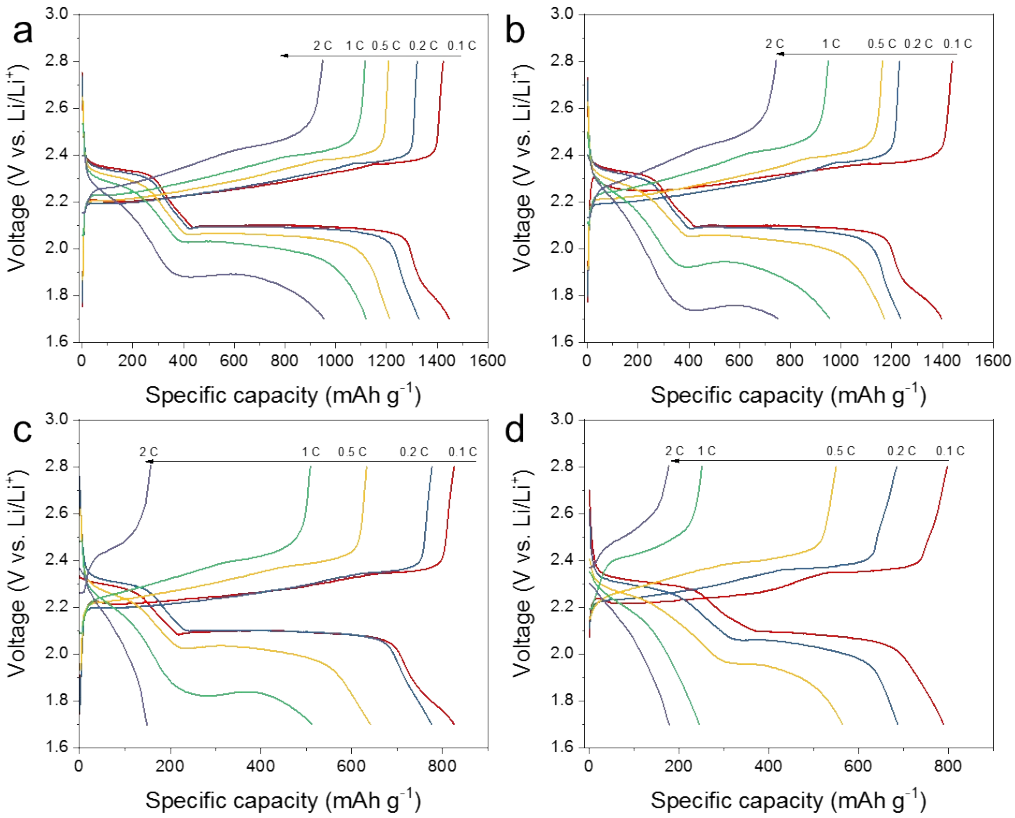

Fig. S4 galvanostatic charge/discharge profiles of (a) NPC, (b) NC, (c) PC and (d)CC

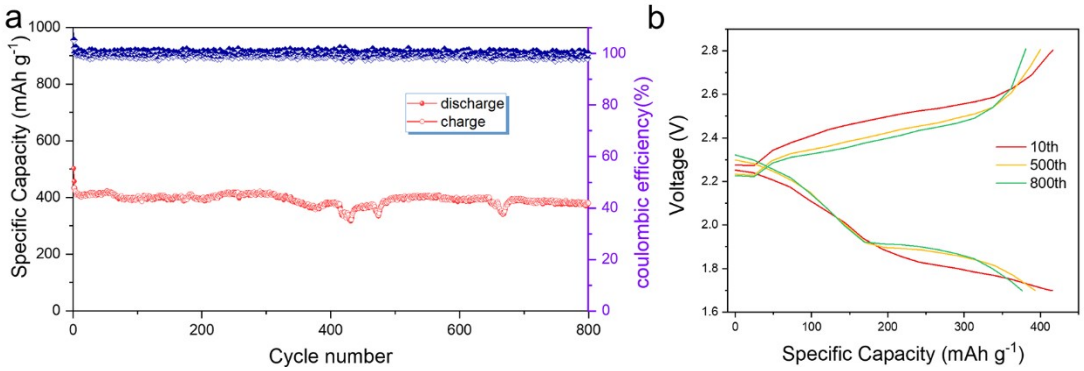

Fig. S5 Cycling performance of 5 C with a sulfur loading of 1 mg cm^{-2}, (b) charge/discharge profiles.

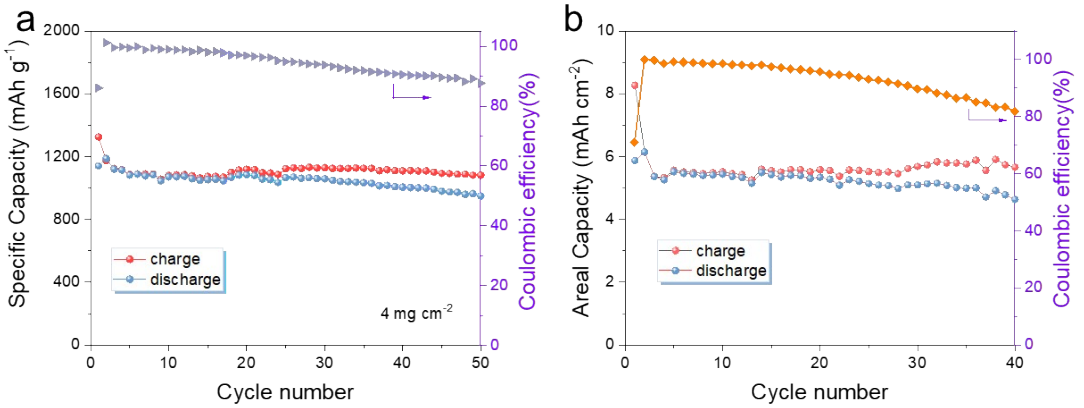

Fig. S6 Cycling performance with high sulfur loading. (a) 0.05 C and (b) 0.2 C

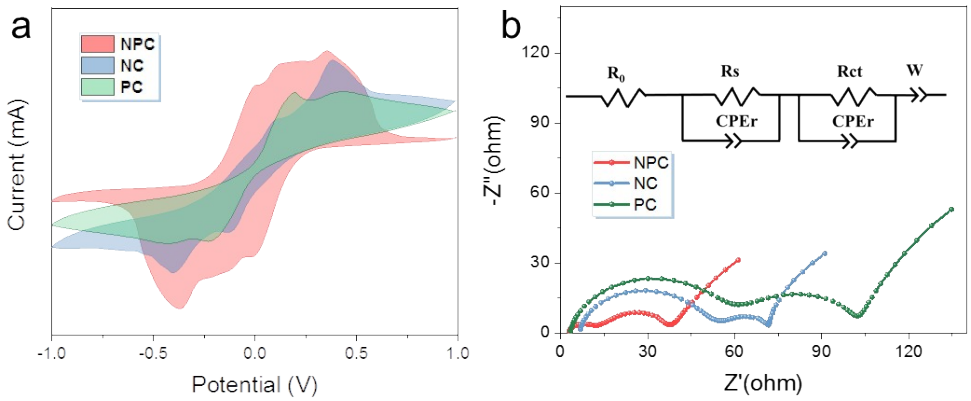

Fig. S7 Symmetric Li_2S_6 cell of (a) CV and (b) EIS plots

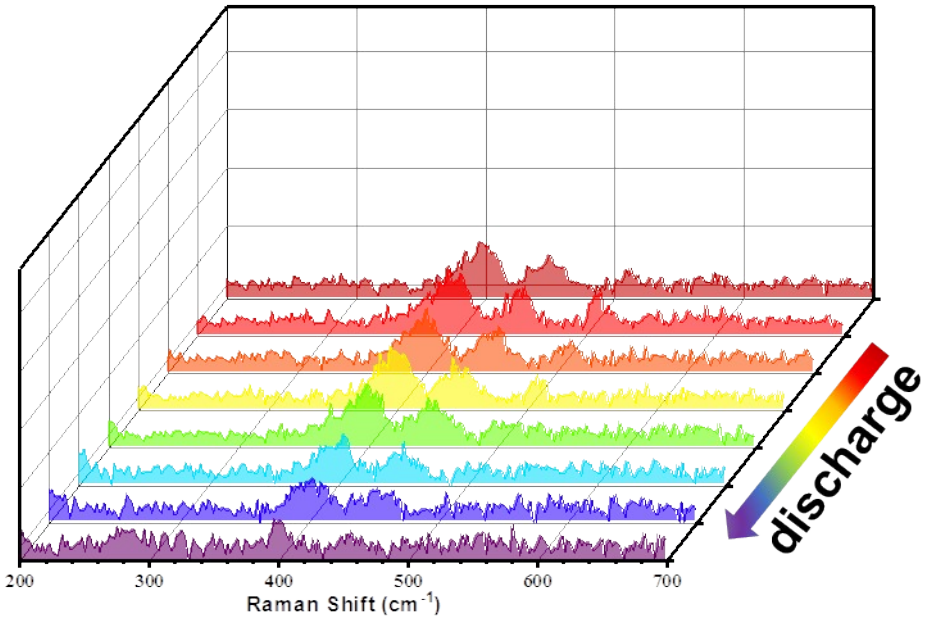

Fig. S8 In-situ Raman spectra of CC

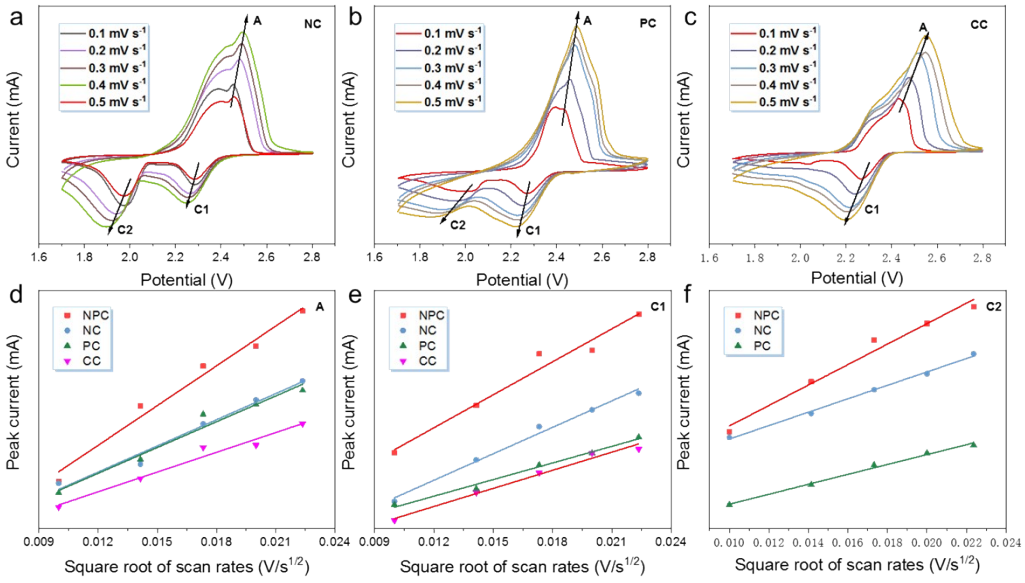

Fig. S9 CV of (a) NC, (b) PC and (c) CC in the range of 0.05–0.4 mV s^{-1}. Peak currents versus square root of scan rates of (d) A peak, (e) C1 peak and (f) C2 peak

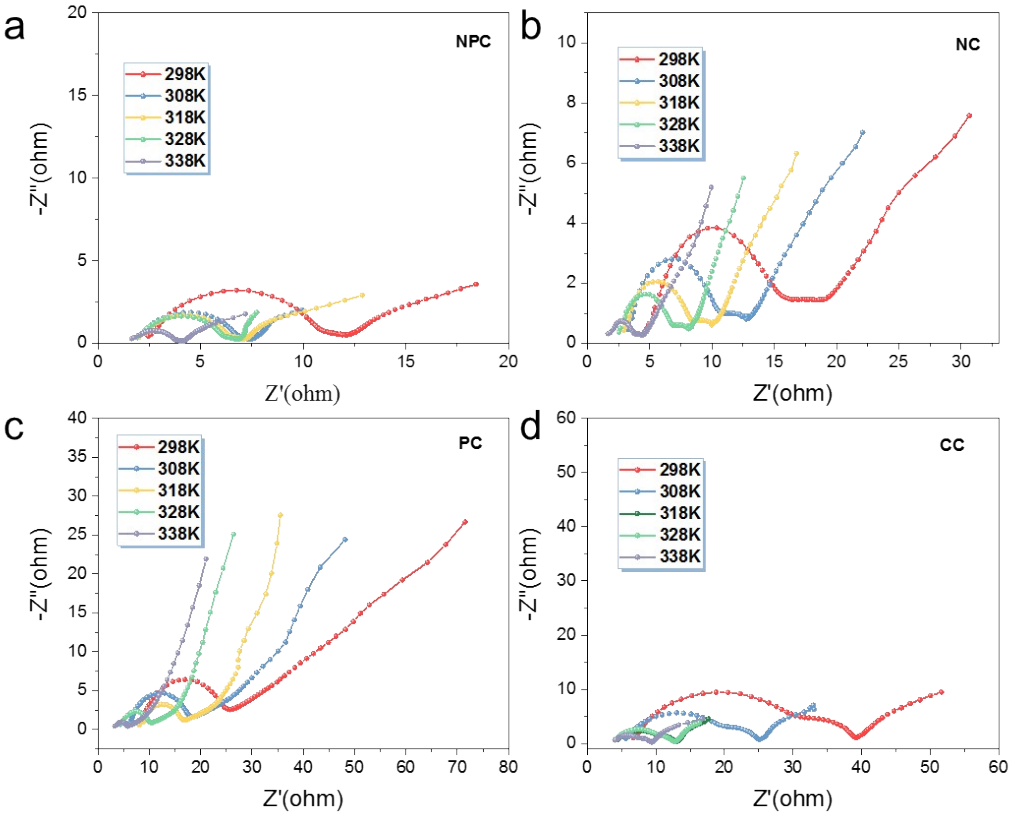

Fig. S10 EIS plots at various temperatures (a) NPC, (b) NC, (c) PC and (d) CC

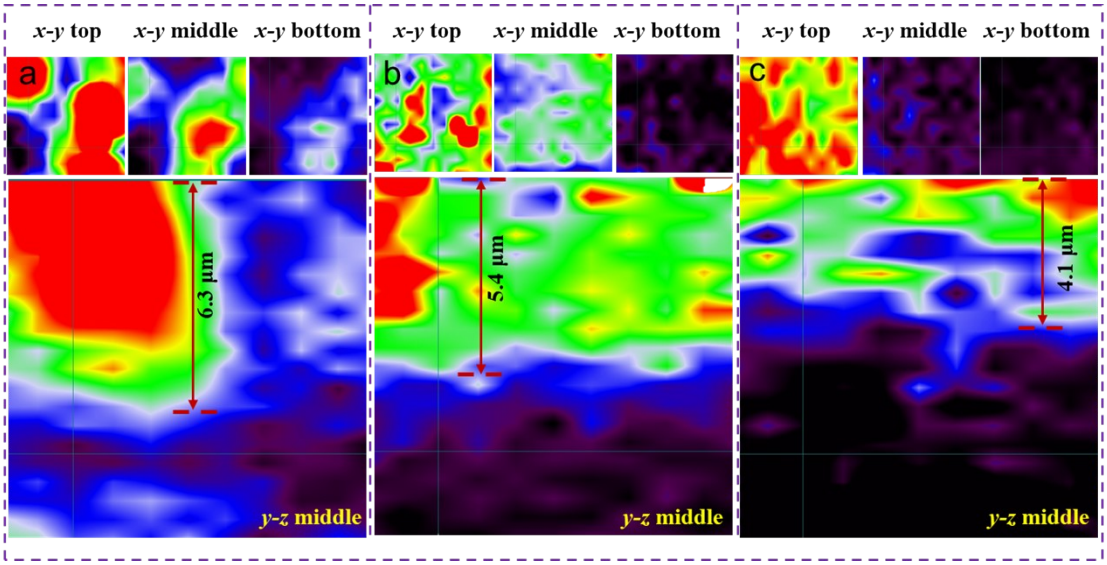

Fig. S11 Raman mapping after dropping Li_2S_6. (a) PC, (b) NC and (c) NPC

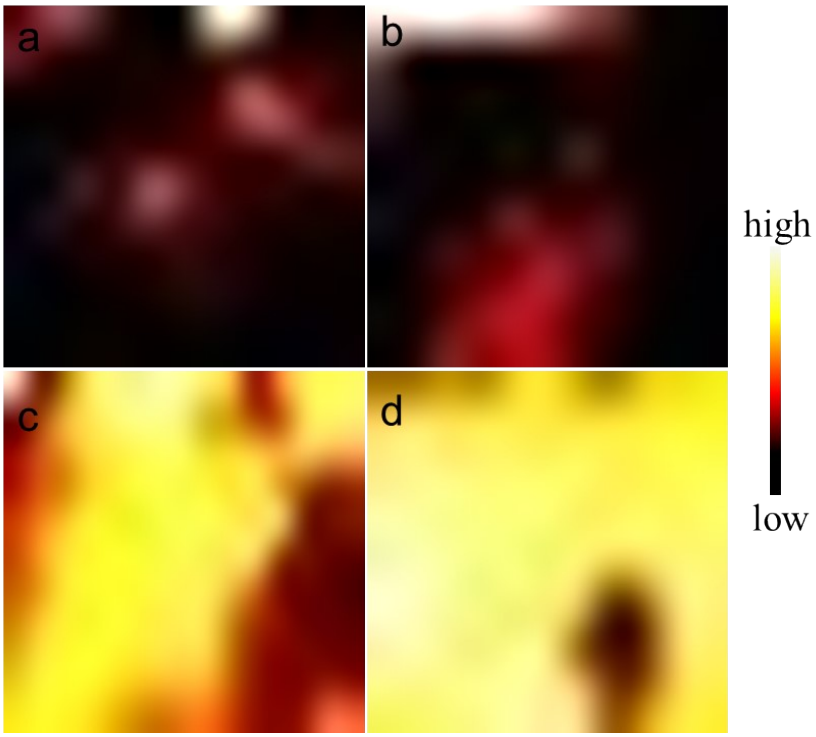

Fig. S12 The LiPS intensity on the surface of cycled Li. (a) NPC, (b) NC, (c) PC and (d) CC

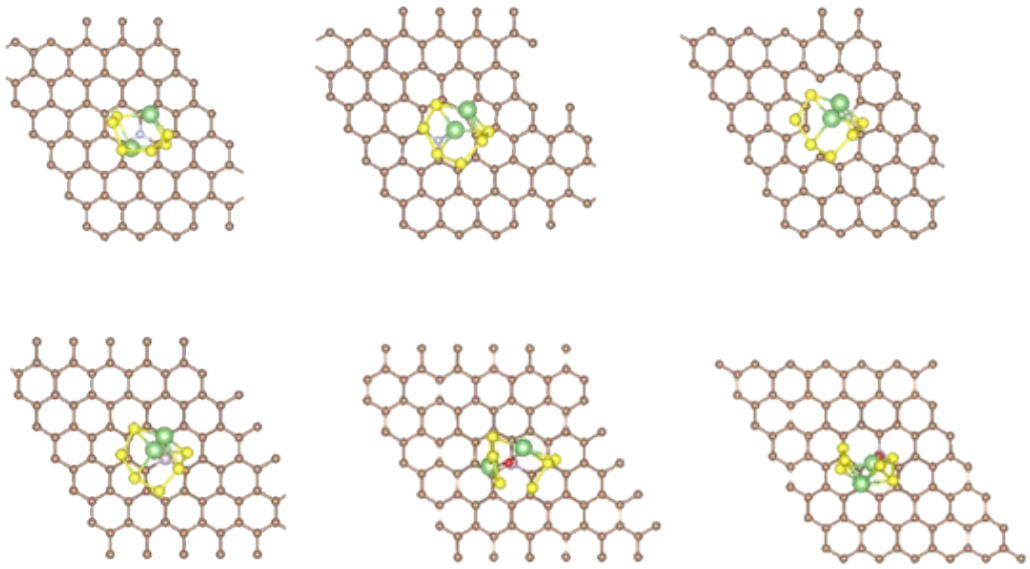

Fig. S13 The binding energy with Li_2S_6.