Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Supporting Information

N-doped Graphitic Ladder-structured Carbon Nanotubes as A Superior Sulfur Host for Lithium–Sulfur batteries

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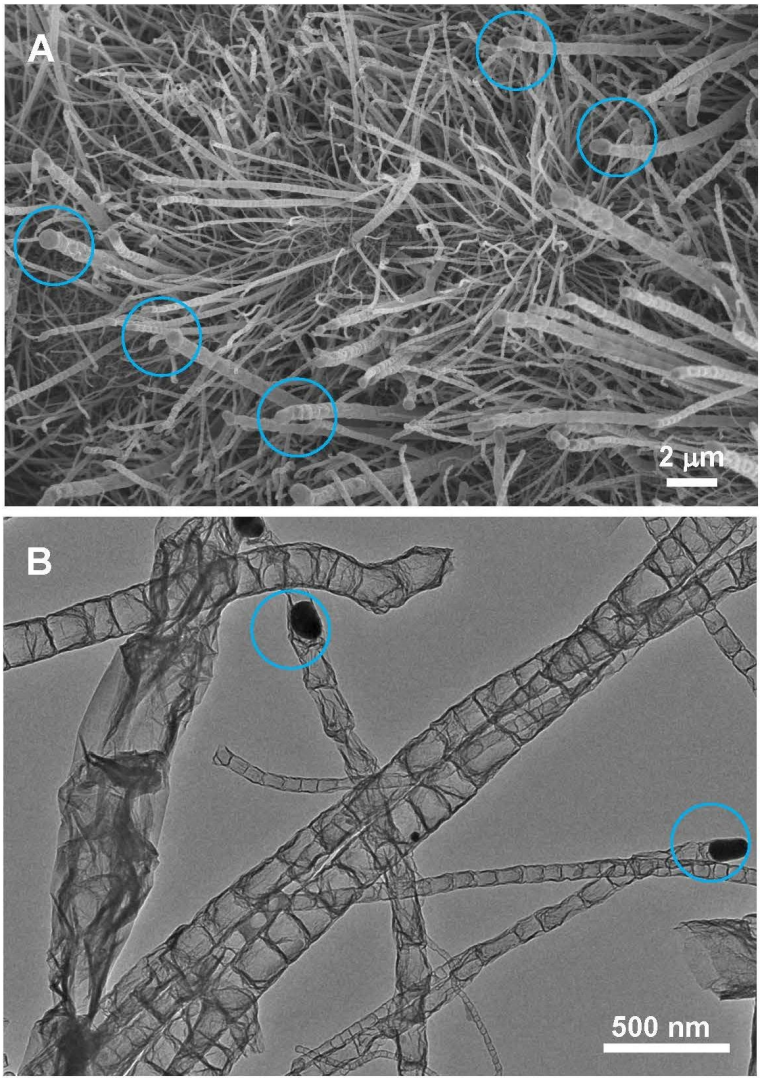

Figure S1. FESEM and TEM images of Co/NGLCNTs obtained at the calcination temperature of 850 °C.

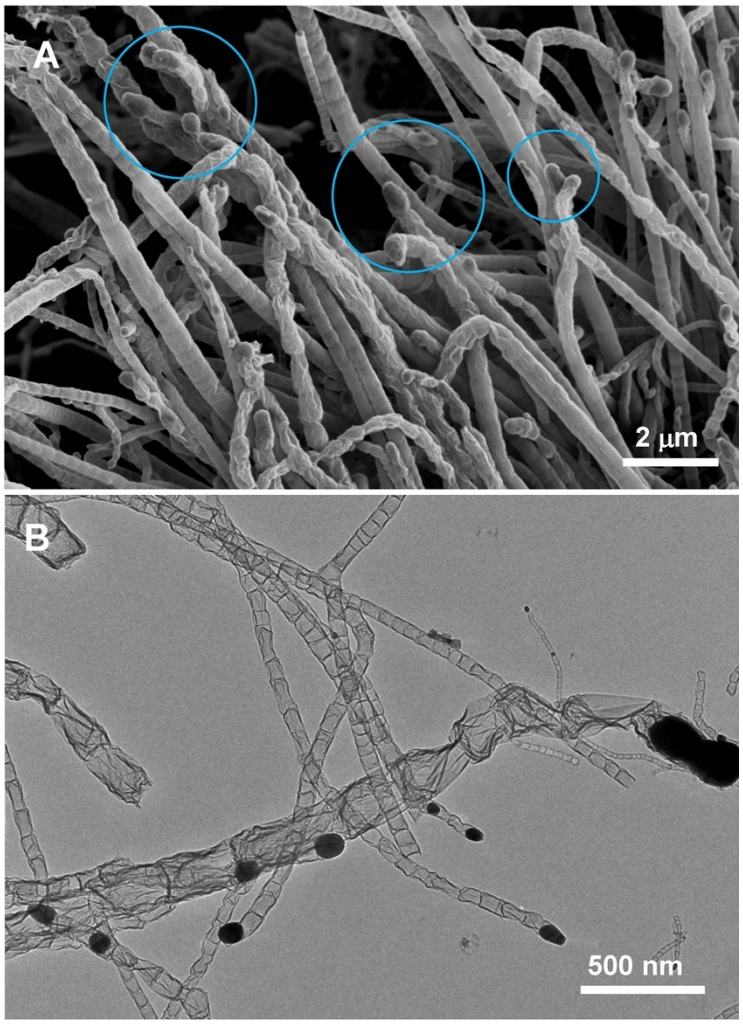

Figure S2. FESEM and TEM images of Co/NGLCNTs obtained at the calcination temperature of 650 °C.

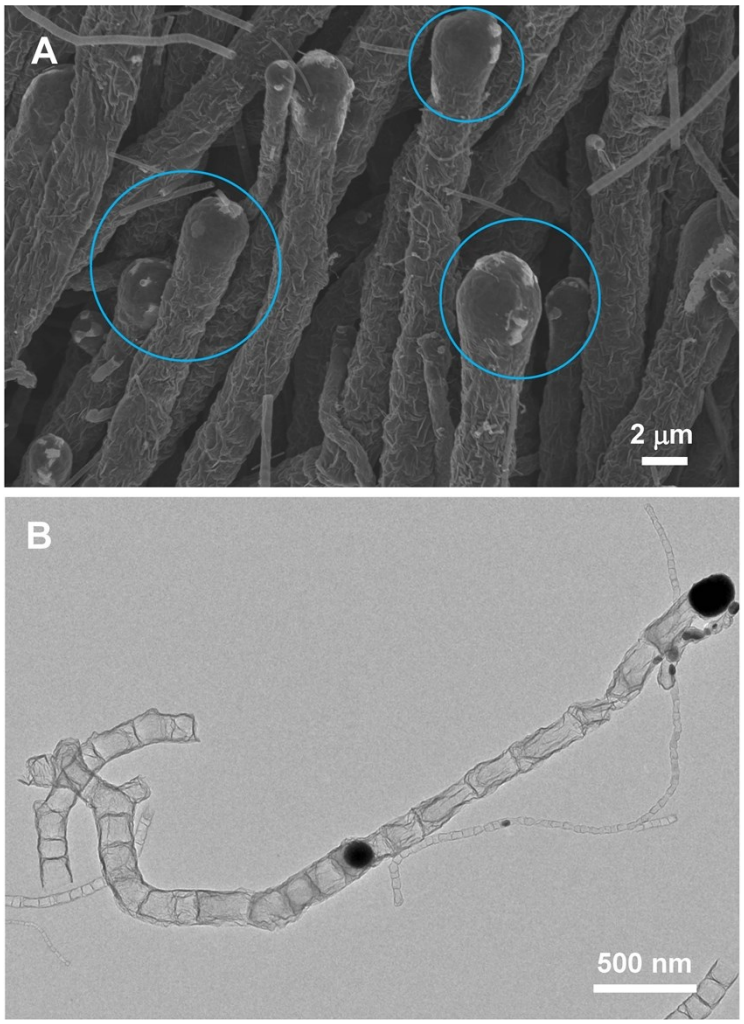

Figure S3. FESEM and TEM images of Co/NGLCNTs obtained at the calcination temperature of 750 °C.

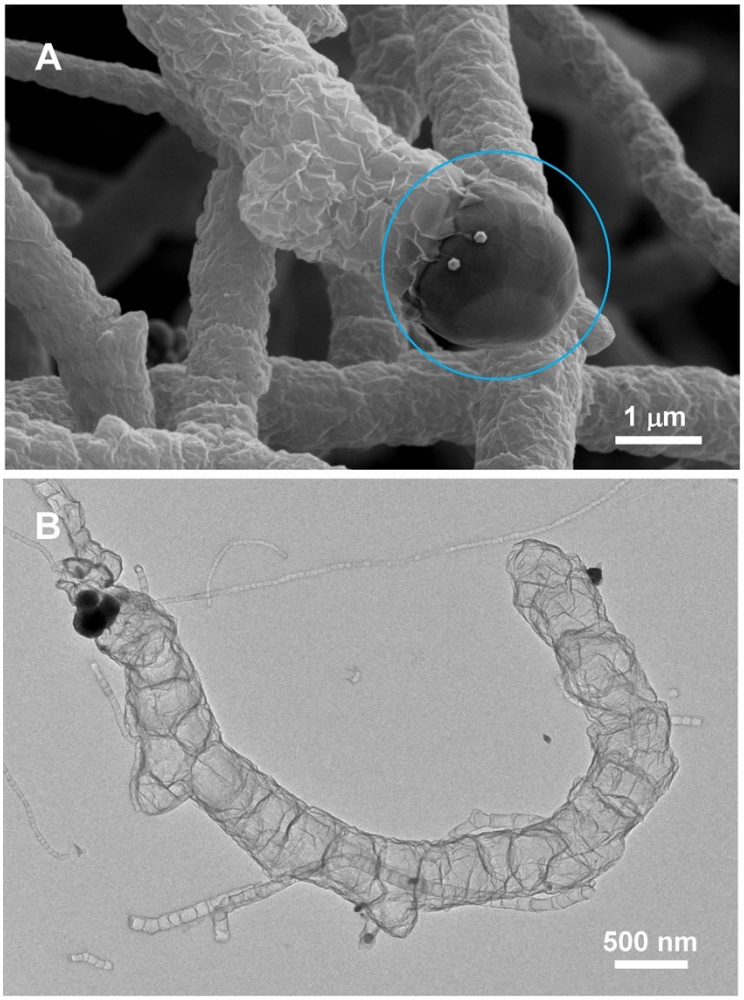

Figure S4. FESEM and TEM images of Co/NGLCNTs obtained at the calcination temperature of 950 °C.

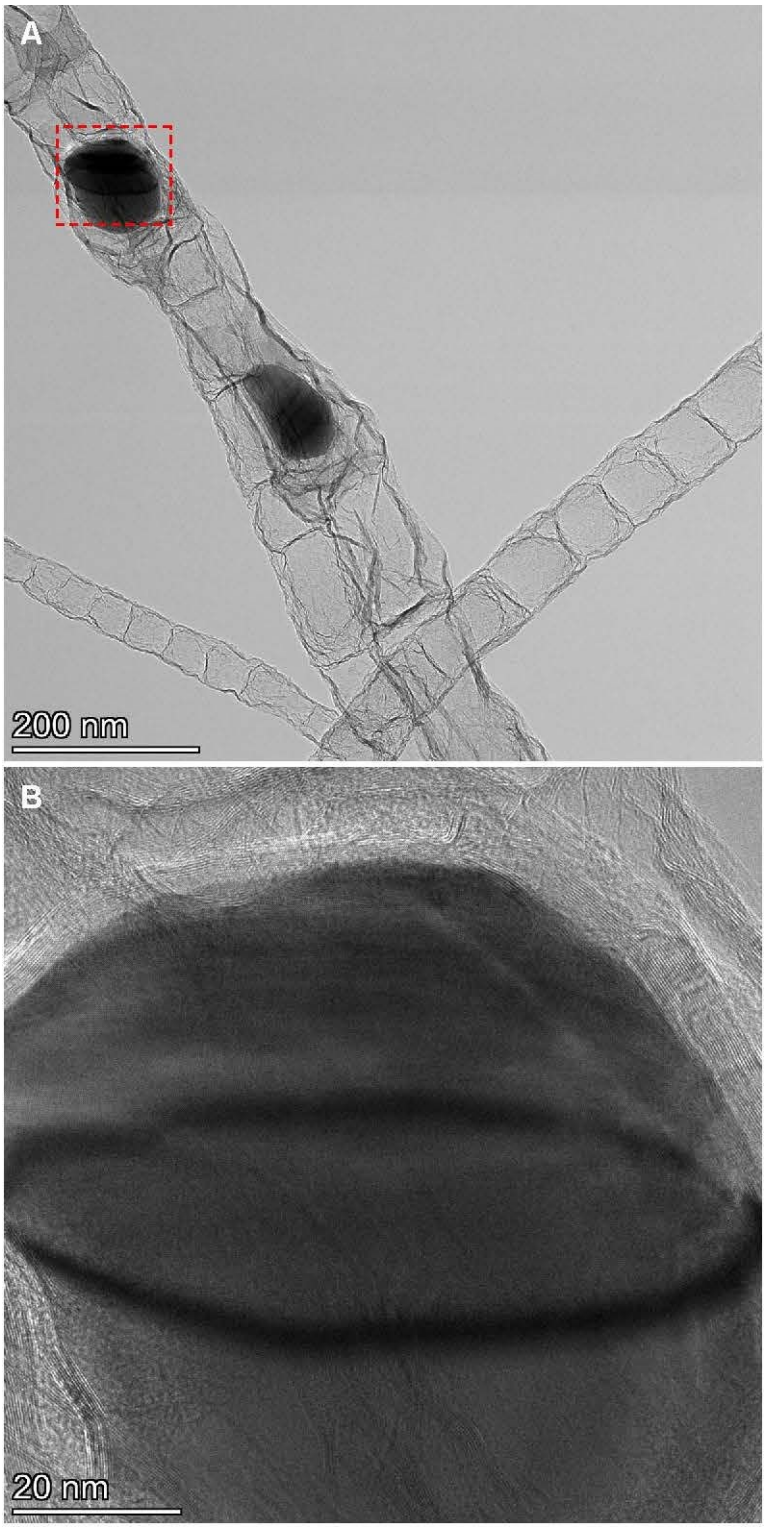

Figure S5. (A) Low-magnification TEM image of of the NGLCNTs. (A) HRTEM image of few-layer graphene coated Co nanoparticle recorded from a marked with red boxes in (A).

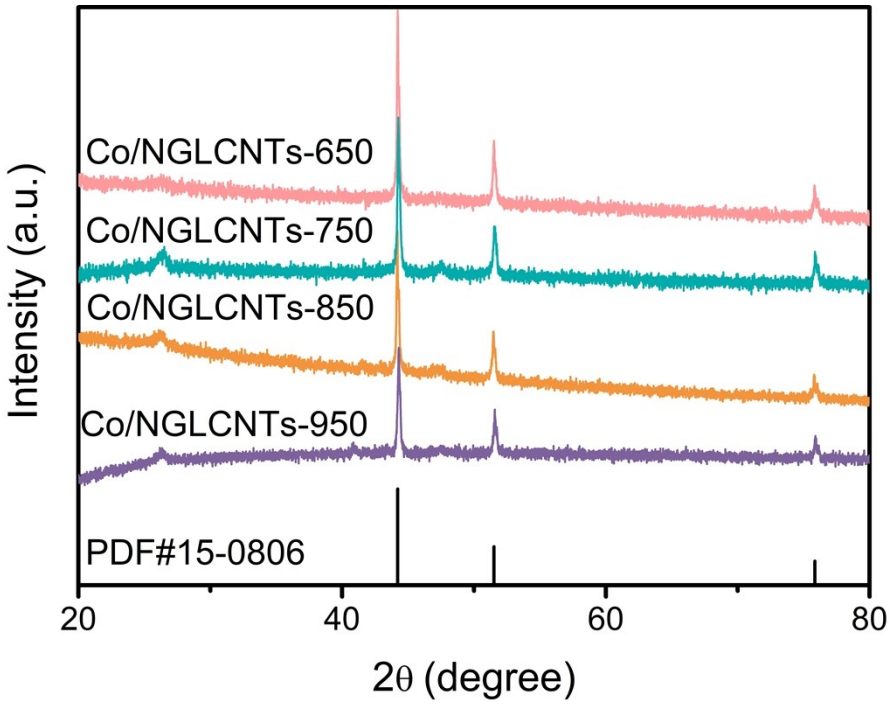

Figure S6. XRD patterns of NGLCNTs obtained at different calcination temperatures.

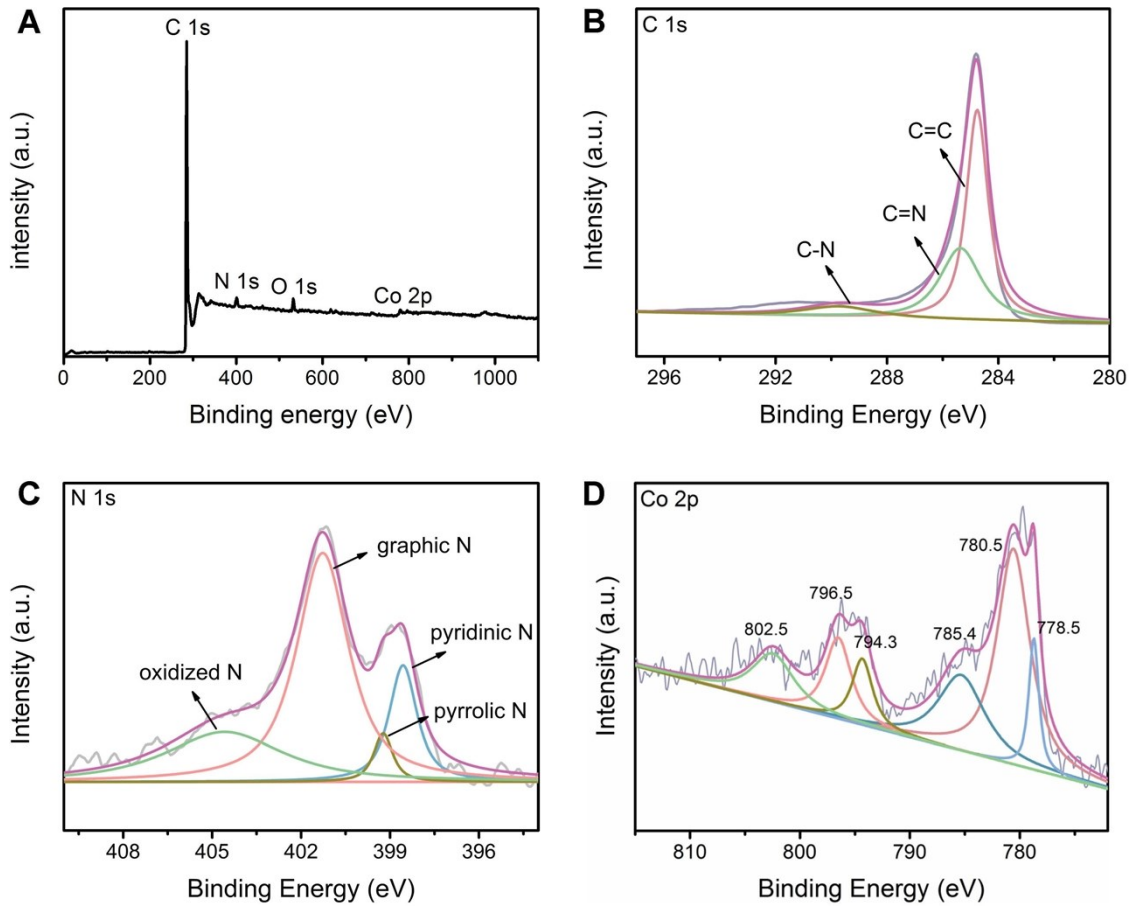

Figure S7. XPS spectra of NGLCNTs-850: (A) survey, (B−D) high-resolution spectra of C 1s, N 1s, and Co 2p.

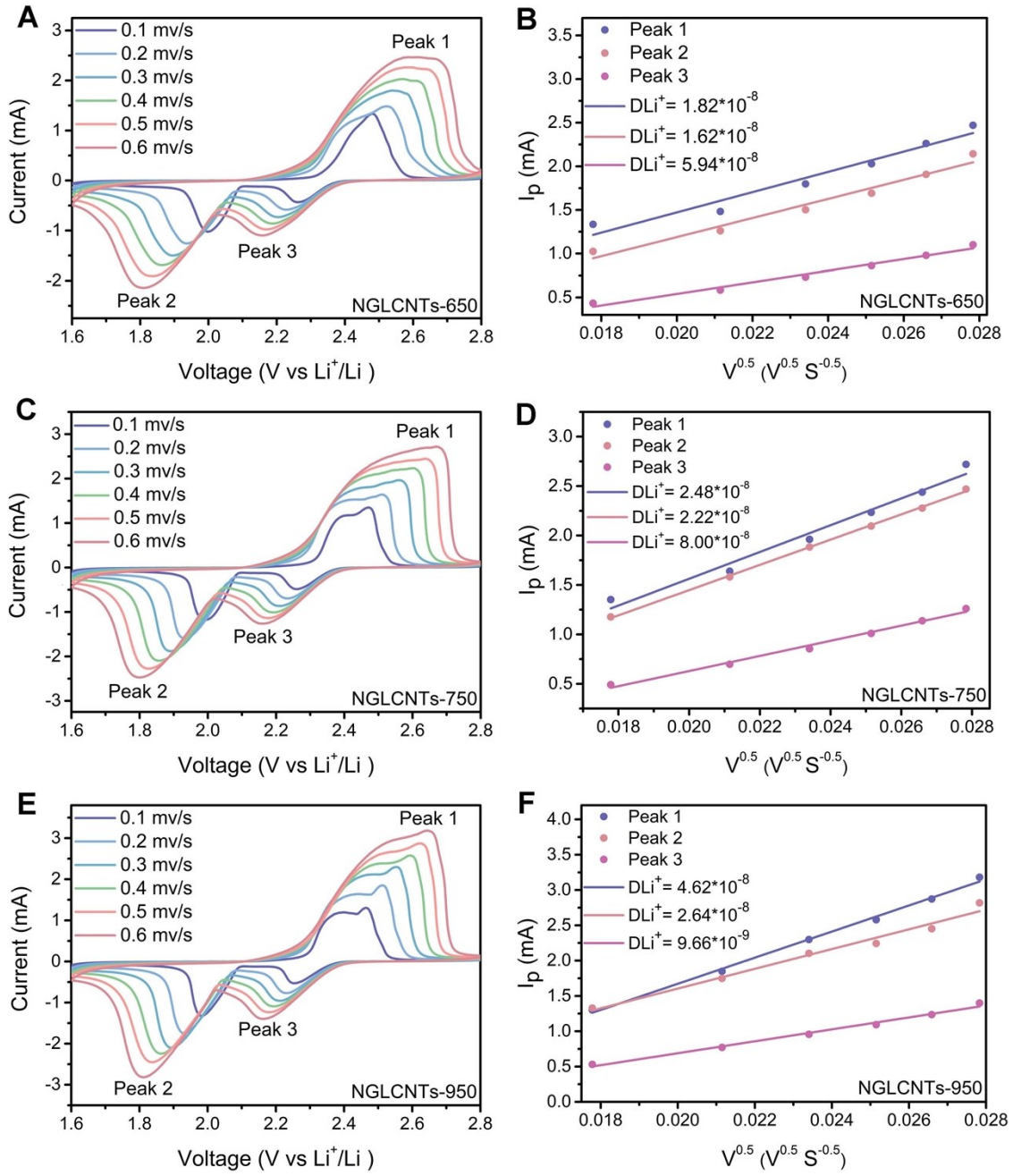

Figure S8. CV curves at different sweep rates and Li^+ diffusion coefficients (A, B) NGLSCNTs-650, (C, D) NGLSCNTs-750, (E,F) NGLSCNTs-950.

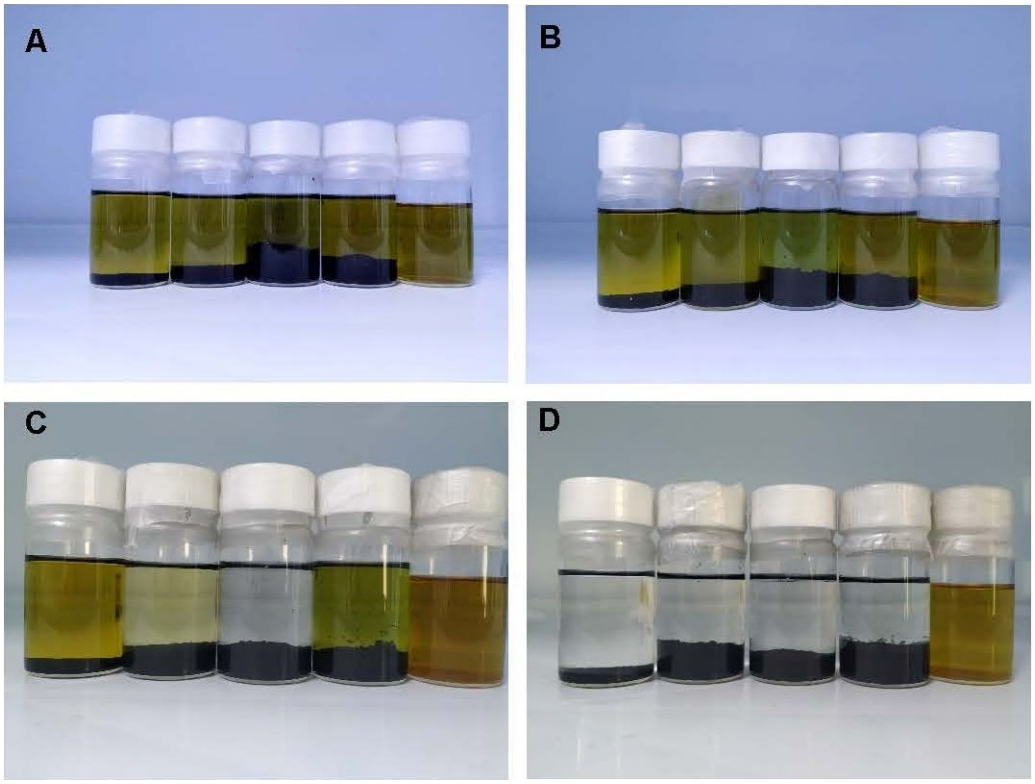

Figure S9. Digital pictures of adsorption test of NGLSCNTs-650, -750, -850, -950 and blank solution (from left to right) in Li_2S_6/DME solution after (A) 5 min and (B) 2 h and (C) 4 h and (D) 48 h.

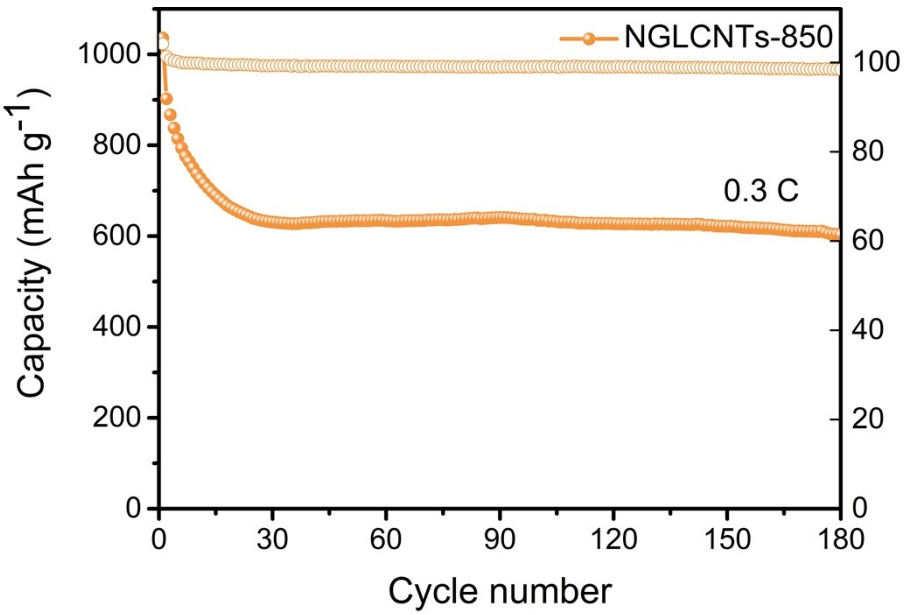

Figure S10. Cycling performance of NGLSCNTs-850/S with the sulfur loading of 80% and the areal sulfur mass loading of 2 mg cm^{-2} at the rate of 0.3 C.

Table S1. Porosity characterization and metal content of four NGLCNTs samples.

Sample	NGLCNTs-650	NGLCNTs-750	NGLCNTs-850	NGLCNTs-950
Specific surface area ($m^2\ g^{-1}$)	75.7	106.5	142.2	97.1
Average pore width (nm)	12.0	18.5	20.8	14.1
Pore volume ($cm^3\ g^{-1}$)	0.348	0.469	0.702	0.470
Co content (mass%)	15.6%	2.14%	7.10%	12.2%
Co atomic percentage	3.76%	0.46%	1.59%	2.87%

The Co residue of NGLCNTs after acid leaching was determined by TGA method. Here, we take the NGLCNTs-650 as example to show the calculation. The product of NGLCNTs after TGA test is Co_3O_4 verified by its XRD pattern. Accroding to the TGA data, the mass of Co_3O_4 is 21.9 assuming the total mass of NGLCNTs-650 is 100. So the weight ratio of Co in NGLCNTs-650 is:

$$\frac{21.9}{M_{Co_3O_4}} \times 3 \times \mathrm{M}_{\mathrm{Co}} \times \frac{1}{100} = 15.6\%$$

Then, the carbon reaches 84.4%. correspondingly, the atomic percentage of Co can also be calculated based on the following equation:

$$\frac{\frac{15.6\%}{M_{\mathrm{Co}}}}{\frac{15.6\%}{M_{\mathrm{Co}}} + \frac{84.4\%}{M_{\mathrm{C}}}} = 3.76\%$$

By the same way, the contents of Co in other NGLCNTs samples can also be calulated and summaried in the above table.

Table S2. Summary of electrochemical parameters of different NGLSCNTs and NGLSCNTs/S.

Parameters	LSCNTs-650/S	LSCNTs-750/S	LSCNTs-850/S	LSCNTs-950/S
D_{Li+} at peak 1/cm^2 s^{-1}	1.82×10^{-8}	2.48×10^{-8}	7.81×10^{-8}	4.62×10^{-8}
D_{Li+} at peak 2/cm^2 s^{-1}	1.62×10^{-8}	2.22×10^{-8}	4.10×10^{-8}	2.64×10^{-8}
D_{Li+} at peak 3/cm^2 s^{-1}	5.94×10^{-9}	8.00×10^{-8}	1.10×10^{-7}	9.66×10^{-9}
Parameters	LSCNTs-650	LSCNTs-750	LSCNTs-850	LSCNTs-950
Li^+ conductivity/mS cm^{-1}	1.00×10^{-2}	2.34×10^{-2}	4.33×10^{-2}	2.50×10^{-2}
Li^+ transfer number	0.69	0.73	0.84	0.53