

Vertical growth of 3D Ni- Co-LDH/N-doped graphene aerogel: cost-effective and high performance sulfur host for Li-S batteries.

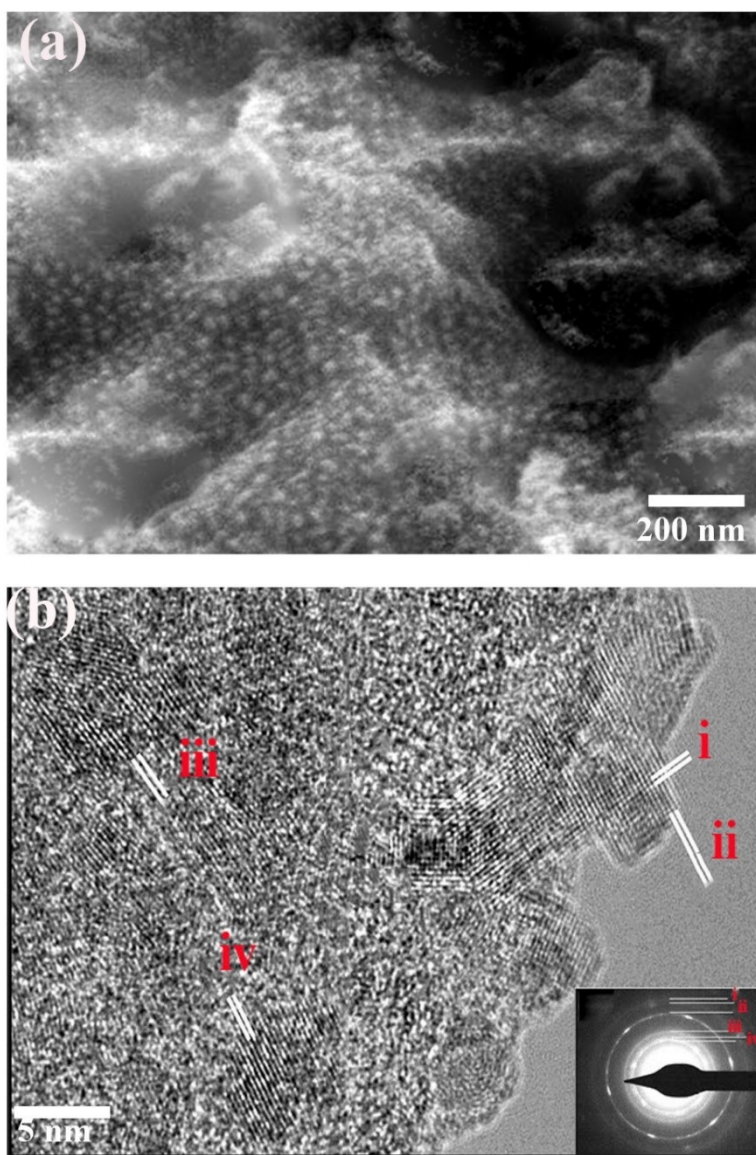


Fig.S1 (a)SEM image of Ni-Co NTA/GNS/S (b) HRTEM image of the Ni-Co NTA/GNS/S

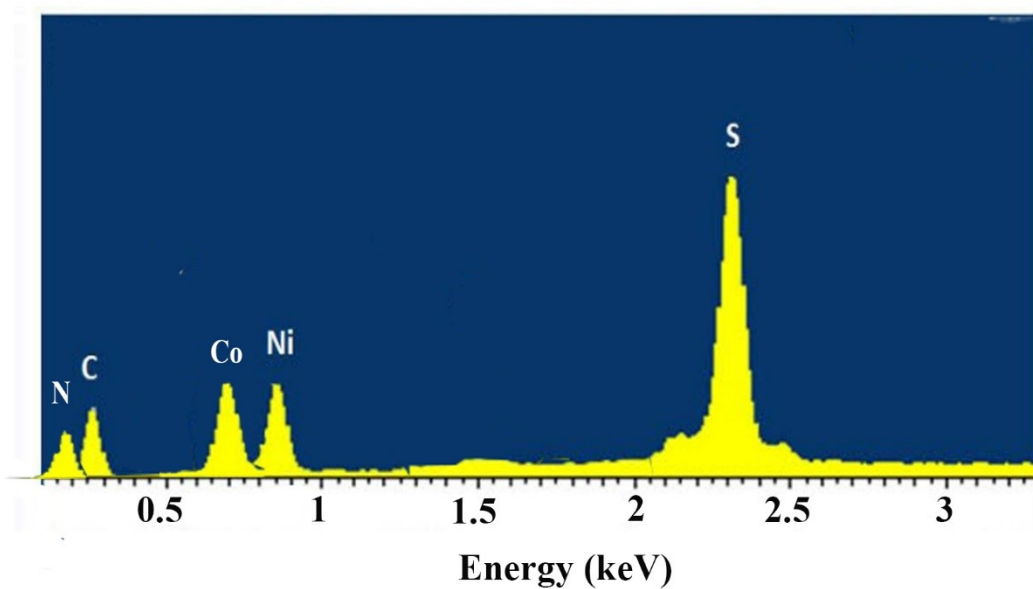


Fig.S2 EDX spectrum of the Ni-Co NTA/GNS/S

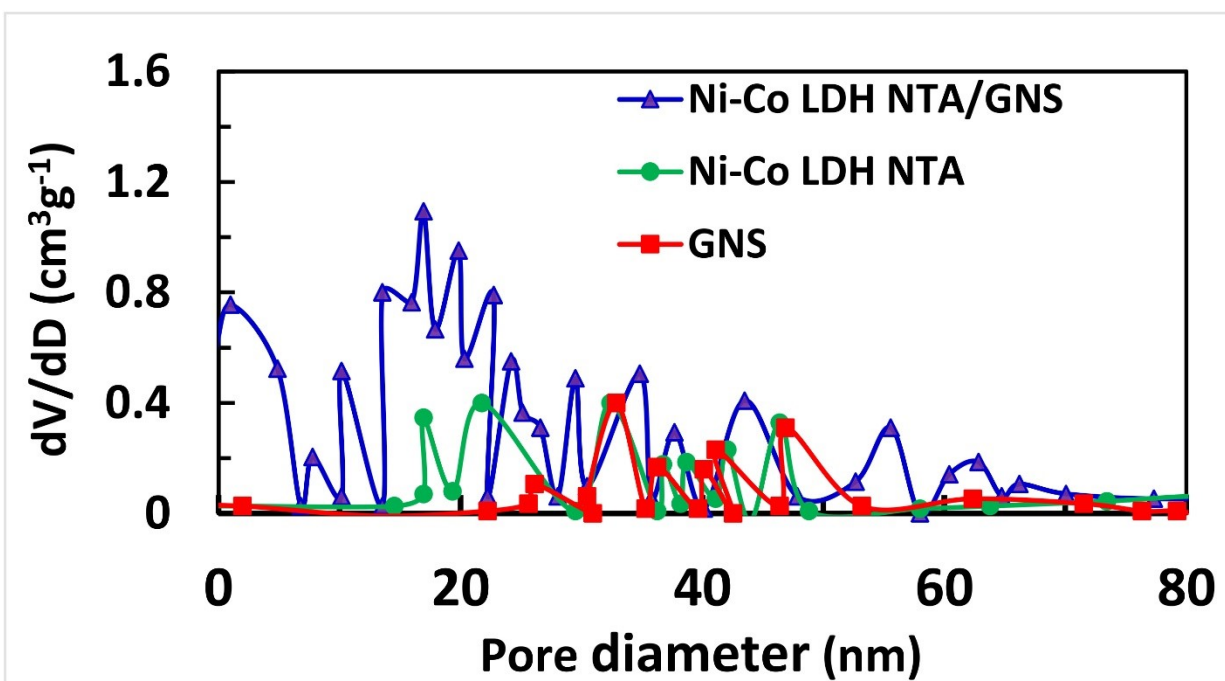


Fig.S3 pore size distribution curves of Ni-Co-LDH NTA/NGS, Ni-Co-LDH NTA and GNS

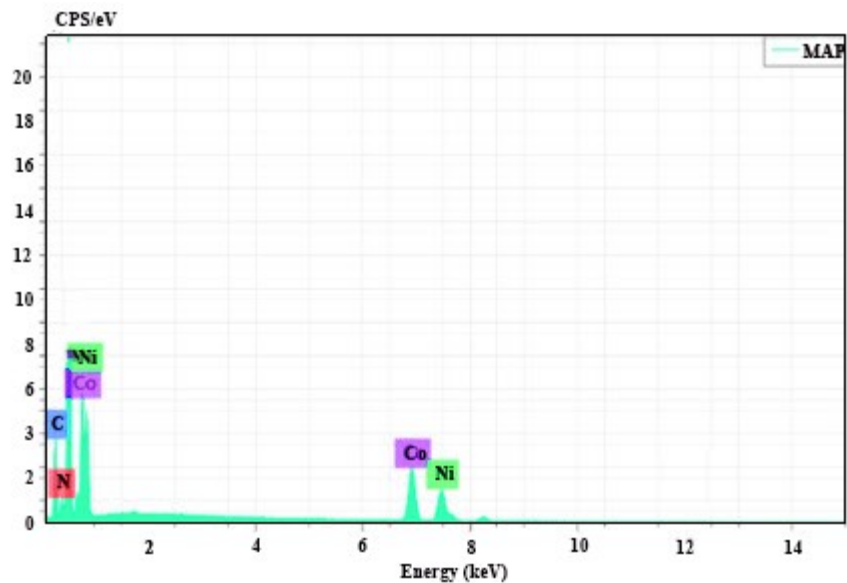


Fig.S4 EDX spectrum of the Ni-Co NTA/GNS

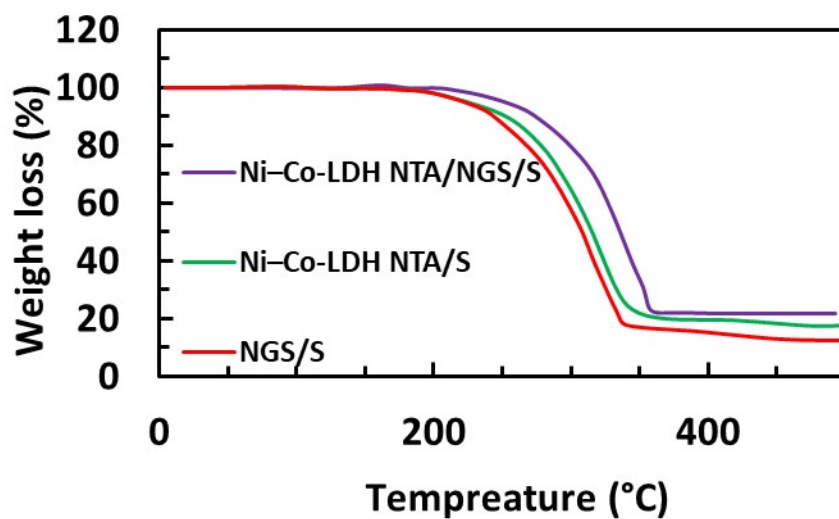


Fig.S5 TG curves of Ni-Co-LDH NTA/NGS/S, Ni-Co-LDH NTA/S and NGS/S

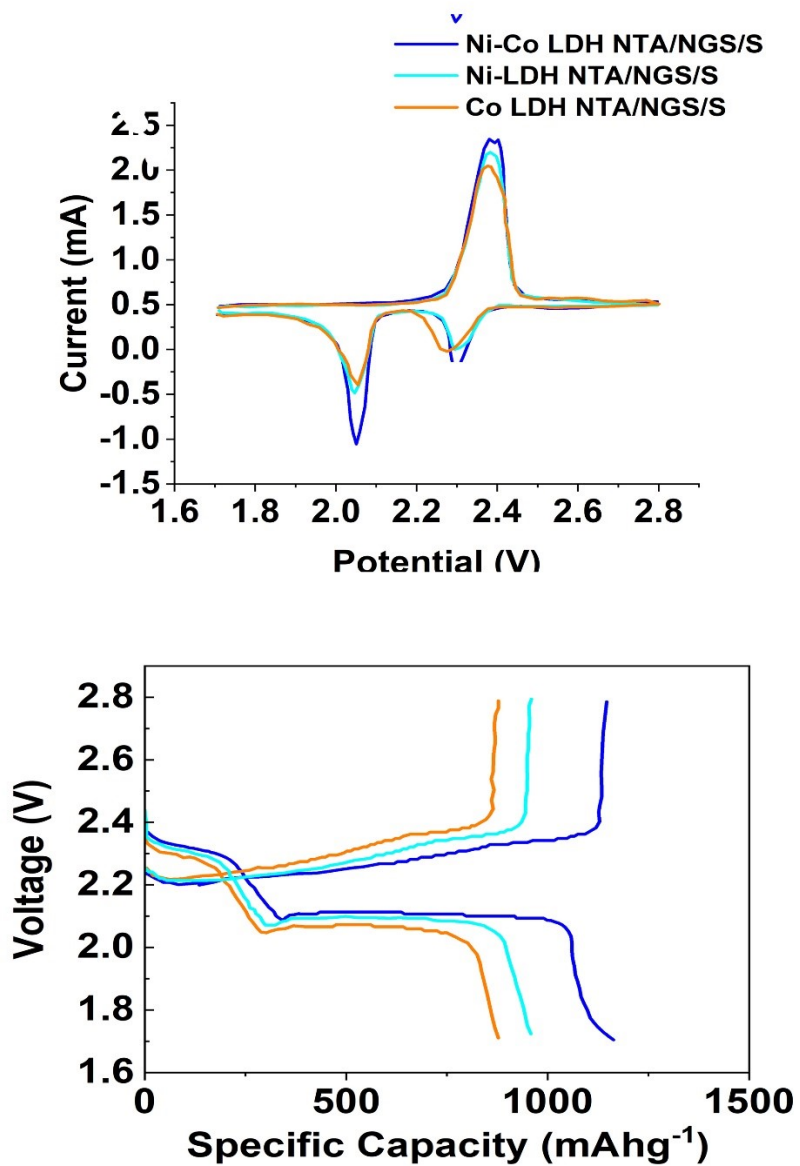
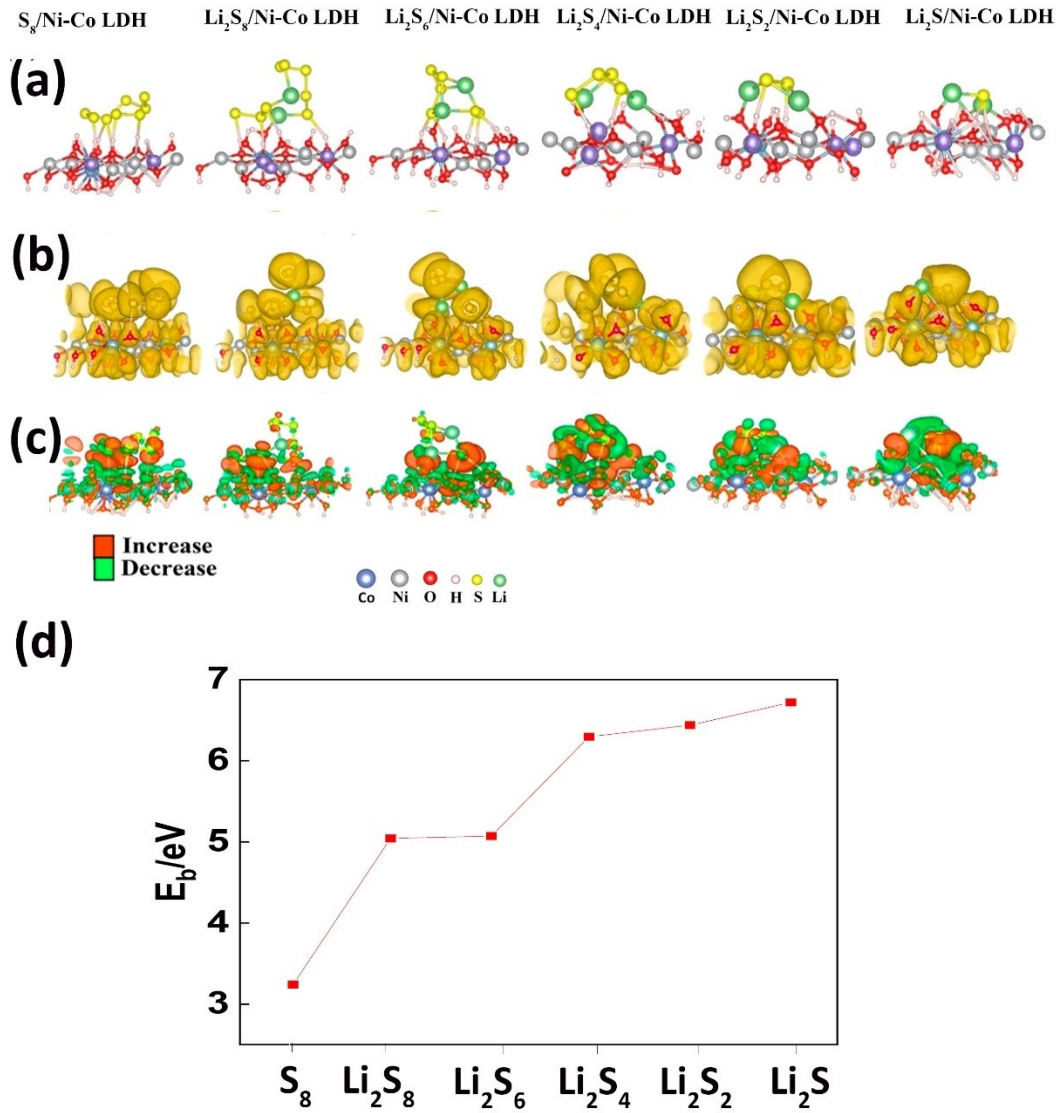


Fig.S6 Electrochemical characteristics of Ni-LDH NTA/S, Co-LDH NTA/S, Ni-Co-LDH NTA /NGS/S cathodes at (a) cyclic voltammogram at 0.1 mV s<sup>-1</sup>. (b) Charging and discharging plots at 0.2 C

**Table S1** The EIS results of various electrodes before cycling

| electrode             | $R_s$ ( $\Omega$ ) | $R_{ct}$ ( $\Omega$ ) |
|-----------------------|--------------------|-----------------------|
| MnO <sub>2</sub> /NPC | 2.16               | 40.81                 |
| NPC                   | 2.08               | 65.41                 |
| MnO <sub>2</sub>      | 2.25               | 83.35                 |

Fig.S7 (a) optimized  $Li_2S$ /Ni-Co LDH structures, (b) Isosurfaces of charge (c) charge density difference, (d) binding energy between Ni-Co LDH and sulfur species

**Table S2 obtained results for NGS from Hall effect experiment**

| <b>Material</b> | <b>Conductivity S cm<sup>-1</sup></b> | <b>Carrier Density/<br/>cm<sup>-3</sup></b> | <b>Hall Coefficient/<br/>cm<sup>3</sup> C<sup>-1</sup></b> | <b>Charge Carrier Mobility cm<sup>2</sup></b> |
|-----------------|---------------------------------------|---|--|---|
| <b>GO</b>       | <b>1.567 × 10<sup>-6</sup> ± 2%</b>   | <b>8.26 × 10<sup>-9</sup></b>               | <b>1.21 × 10<sup>10</sup></b>                              | <b>1.960 × 10<sup>-2</sup></b>                |
| <b>NGS</b>      | <b>0.781 ± 2%</b>                     | <b>-0.083</b>                               | <b>11.932</b>  | <b>0.368</b>                                  |

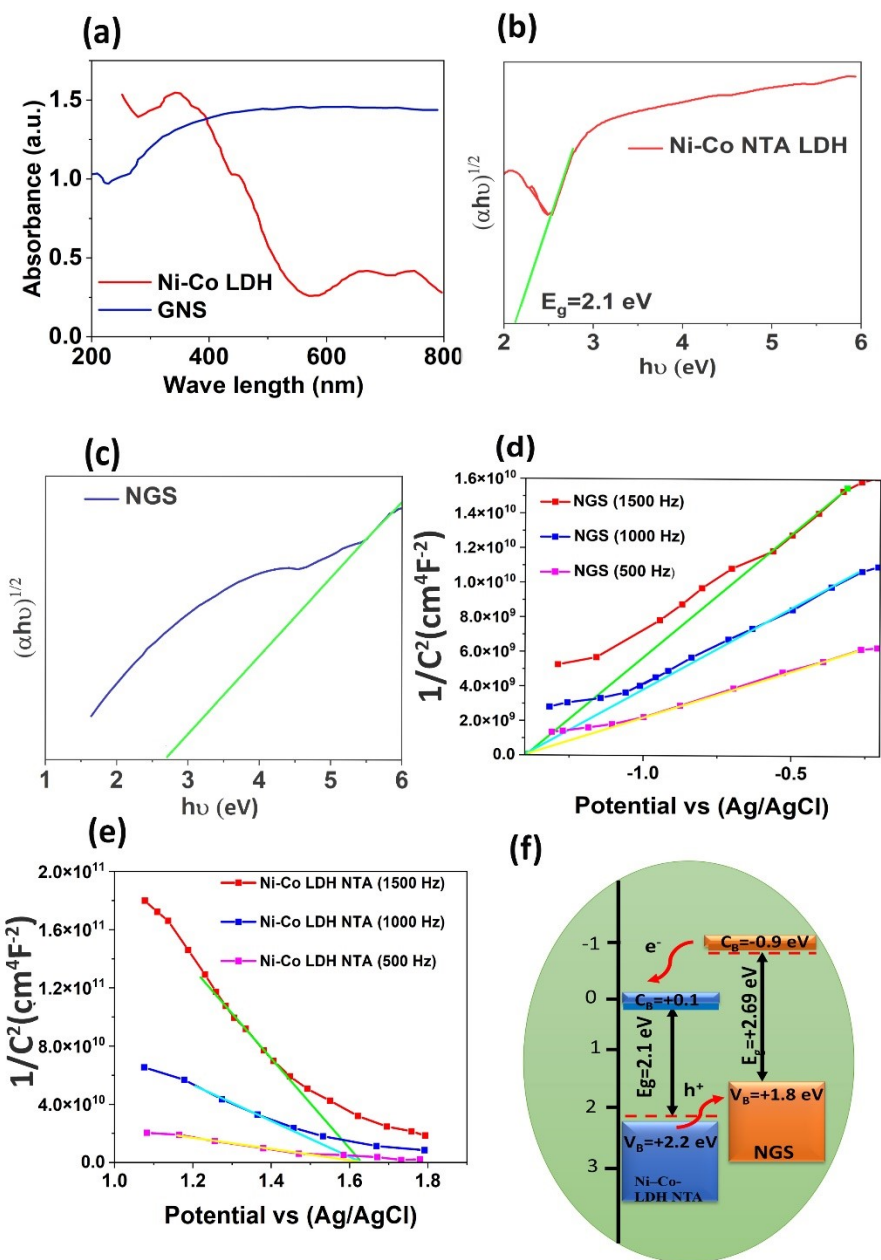


Fig.S8 UV-vis absorption spectra of Ni-Co LDH NTA and NGS, (b) and (c) Tauc plots for Ni-Co LDH NTA and NGS, respectively, Mott-Schottky plot of (d) NGS and (e) Ni-Co LDH NTA (f) Proposed electron transfer mechanism based on Mott-Schottky results