Supporting Information

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Compact High Volumetric and Areal Capacity Lithium Sulfur Battery through Rock Salt induced Polymodally Distributed Sulfur Host

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**Supporting Figures:**

**Figure S 1:** Zeta potential measurements displaying mobility plots with corresponding table of calculated Zeta potential of samples without (a) and with (b) NaCl. 6 runs were conducted for each sample to ensure repeatability.
Figure S 2: TEM image of Poly-NPC prior to silica removal indicating lighter and darker spots throughout its structure. Dotted circle marks a lighter spot.
Figure S 3: Dynamic light scattering particle size distribution of sample with and without rock salt.
Figure S 4: Thermogravimetric analysis curve indicating 70% sulfur content in Poly-NPC /sulfur composite
Figure S 5: Pore size distribution per: a) BJH desorption, b) DFT and adsorption and desorption curve of c) Poly-NPC and d) 0% NaCl-NPC.
Figure S 6: Diagram used to deduce the inter-silica pore size, the circles represent silica nanoparticle of diameter ~20 nm. Whereas the small solid circle in the center of the diagram represents the inter-silica pore. The triangle is drawn from the center point of each silica particle. The dotted triangle is drawn from the center of the inter-silica pore to the center of the top silica particle (length=x nm) and to the bottom left edge of the top silica particle (length=10 nm), forming a right angle triangle with inner 60° angles. In other words, the dotted triangle has a height of 10 nm and an unknown hypotenuse of x nm. Since the length of one side and inner angles are known, from simple trigonometry of right angle triangles, the unknown x is calculated to be 11.54. Since x is actually the sum of the radius of the inter-silica pore and the radius of a silica particle (~10 nm). Then the radius of the inter-silica pores can be calculated to be ~1.5 nm which would yield a diameter of ~3 nm, matching roughly the pore size distribution obtained from nitrogen sorption experiments.
Figure S 7: a) XPS binding energy spectrum of Poly-NPC with 14.9 at% of nitrogen and b) the full XPS scan proving the proportion of nitrogen in carbon material.

Figure S 8: Cycle performance at 0.5 C over 100 cycles of 0% NaCl sample with 70% S
Figure S 9: a) Cyclic voltammetry of 4 mg cm$^{-2}$ cell at 0.1 mV s$^{-1}$ and b) corresponding charge/discharge voltage profile of 4 mg cm$^{-2}$ cell.

Supporting Tables:

Table S 1: Performance summary of recent blade casted lithium sulfur electrodes

<table>
<thead>
<tr>
<th>Title/Year</th>
<th>Traditional Battery Manufacturing</th>
<th>Sulfur Loading (%wt of cathode coating)</th>
<th>Areal Capacity</th>
<th>Thickness</th>
<th>Electrode’s Volumetric Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Energy Density Lithium-Sulfur Batteries: Challenges of Thick Sulfur Cathodes/2015</td>
<td>Yes</td>
<td>3.5 mg cm$^{-2}$ (64%)</td>
<td>3.5 mAh cm$^{-2}$</td>
<td>80 μm</td>
<td>339 mAh cm$^{-3}$</td>
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<tr>
<td>Long-Life and High-Areal-Capacity Li-S Batteries Enabled by a Light-Weight Polar Host with Intrinsic Polysulfide Adsorption/2016</td>
<td>Yes</td>
<td>5 mg cm$^{-2}$ (56.25%)</td>
<td>4.27 mAh cm$^{-2}$</td>
<td>150 μm</td>
<td>284 mAh cm$^{-3}$</td>
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<tr>
<td>A Comprehensive Approach toward Stable Lithium-Sulfur Batteries with High Volumetric Energy Density /2016</td>
<td>Yes</td>
<td>5.1 mg cm$^{-2}$ (65.45%)</td>
<td>5 mAh cm$^{-2}$</td>
<td>215 μm</td>
<td>239 mAh cm$^{-3}$</td>
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<tr>
<td>Investigation of non-woven carbon paper as a current collector for sulfur positive electrode—Understanding of the mechanism and potential applications for Li/S batteries/2016</td>
<td>Yes</td>
<td>4.4 mg cm$^{-2}$ (80%)</td>
<td>4.96 mAh cm$^{-2}$</td>
<td>270 μm</td>
<td>183 mAh cm$^{-3}$</td>
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<td>Cathode materials based on carbon nanotubes for high-energy-density lithium-sulfur batteries/2014</td>
<td>Yes</td>
<td>3.72 mg cm$^{-2}$ (45%)</td>
<td>3.21 mAh cm$^{-2}$</td>
<td>215 μm</td>
<td>149 mAh cm$^{-3}$</td>
</tr>
<tr>
<td>This work</td>
<td>Yes</td>
<td>4 mg cm$^{-2}$ (60.9%)</td>
<td>5.4 mAh cm$^{-2}$</td>
<td>109 μm</td>
<td>495 mAh cm$^{-3}$</td>
</tr>
</tbody>
</table>
Reference