**Supporting Information**

**Mass Production of Calendering-Compatible Sulfur-Rich Secondary Particles via Hail-Inspired Nanostorm Technology for Advanced Metal-Sulfur Batteries**

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Figure S1. SEM image of pristine **a)** sulfur, **b)** KB and **c)** Co2O3,scale bar is 5 um.

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Figure S2. TEM image of KB with a half-open hollow structure.

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Figure S3. **a)** N2 adsorption-desorption isotherms and **b)** the pore size distribution of sulfur AP@HTM-12h, sulfur SP@HSN-2min, sulfur SP@HSN-3min and sulfur SP@HSN-5min.

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Figure S4. SEM image of the resulted **a)** sulfur SP-HSN-2min, **b)** sulfur SP-HSN-3min and **c)** sulfur SP-HSN-5min, scale bar is 5 um.

Table S1. Summarize of the pore property of all samples.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sample | KB | sulfur AP@HTM | sulfur SP@HSN-2min | sulfur SP@HSN-3min | sulfur SP@HSN-5min |
| S(BET)  (m2/g) | 1423 | 28.5 | 12.9 | 8.1 | 3.2 |

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Figure S5. SEM image of the **a)** sulfur AP@HTM cathode and **b)** sulfur SP@HSN with same sulfur loading of ~ 5 mg cm-2, scale bar is 500 um.

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Figure S6. The photo of **a)** sulfur AP@HTM cathodes with a sulfur loading of 5 mg cm-2 and 10 mg cm-2, **b)** sulfur SP@HSN cathodes with a sulfur loading of 5 mg cm-2 and 15 mg cm-2.

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Figure S7. SEM image of the AP@HTM cathodes after calendering at 4 Mpa in various temperature, **a)** 40℃, **b)** 60℃, **c)** 80℃, and the SP@HSM cathodes **e)** before and after calendering at 4 Mpa in various temperature, **d)** 40℃, **e)** 60℃, **f)** 80℃, the sacle bar is 20 um.

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Figure S8. Comparsion of the thickness of sulfur AP@HTM and sulfur SP@HSN electrodes under various compression perssures.

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Figure S9. SEM image of the sulfur AP@HTM cathodes **a)** before and **b)** after calnedering at 4 Mpa, sulfur SP@HSN cathodes **c)** before and **d)** after calendering at 4 Mpa.

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Figure S10. The discharge/charge curves of sulfur SP@HSN cathdoes at various current desnities from 0.1C to 2C.

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Figure S11. Nyquist plots of the sulfur AP@HTM and sulfur SP@HSN cathodes at open potential.

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Figure S12. **a)** Cycle performance of pouch-cells assembled by various sulfur loading of sulfur SP@HSN cathodes. The discharge/charge curves of pouch-cells based on different cathodes with sulfur loading of **b)** 6 mg cm-2 **c)** 9 mg cm-2 and **d)** 12 mg cm-2.