Supplementary Materials for Manuscript:

Performance of a thermally regenerative battery with 3D printed Cu/C composite electrodes: Effect of electrode pore size

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1 Comparison of electrodes before and after carbonization

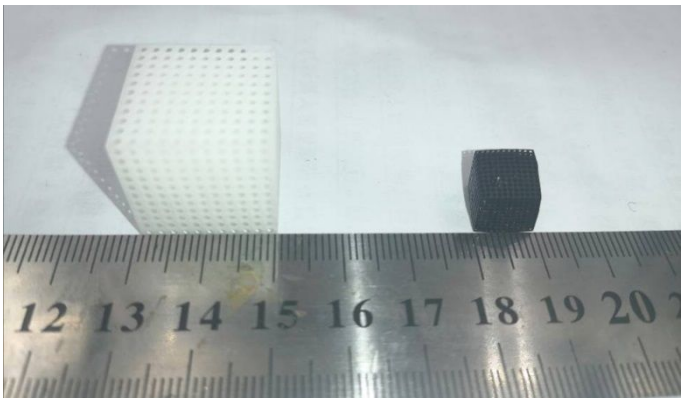

Figure S1. Comparison of electrodes before and after carbonization

As shown in Figure S1, the porous UV-curable resin models size reduced by 50% after carbonization

2 Schematic of thermally regenerative ammonia-based battery (TRAB)

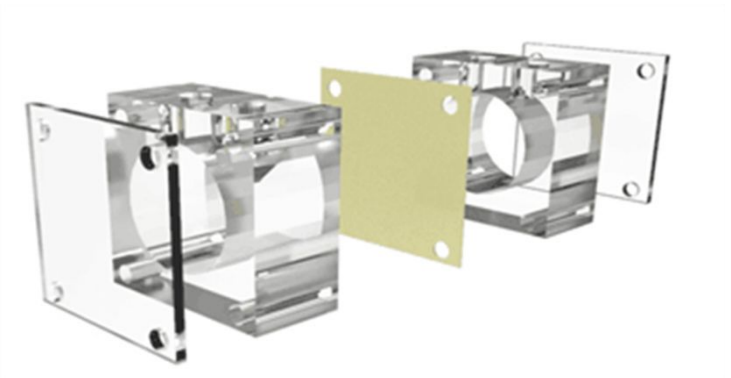

Figure S2. Schematic of TRAB reactor in this study

As shown in Figure S2, the battery chamber is a cylindrical chamber with a bottom diameter of 3 cm and a height of 2 cm. The two chambers are separated by an anion exchange membrane.

3 Equivalent circuit for cell impedance analysis

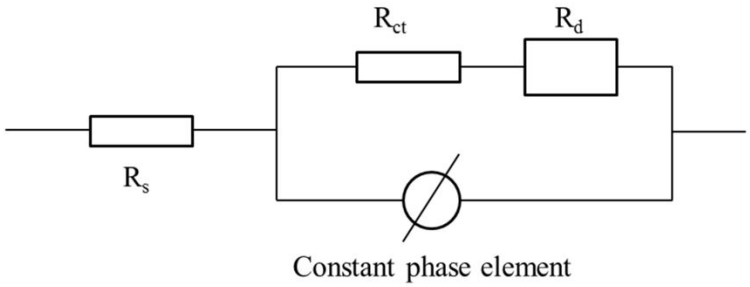

Figure S3. Equivalent circuit for cell impedance analysis.

Equivalent circuit for cell impedance analysis is shown in Figure S3. The electrolyte concentration is 0.1 mol/L $CuSO_4 \cdot 5H_2O$, 2.5 mol/L $(NH_4)_2SO_4$ and 1mol / L NH_4OH. The reaction resistance was the sum of charge transfer resistance (R_{ct}), and diffusion resistance (R_d).

4 The maximum power density with different pore size (based on electrode mass)

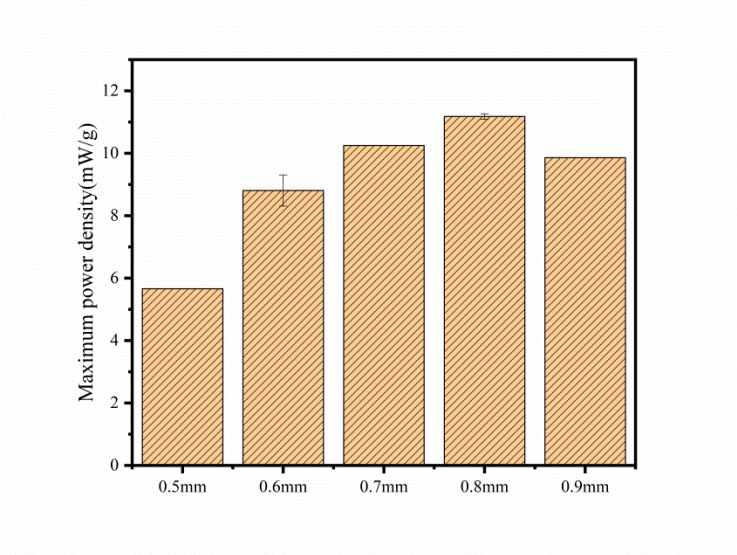

Figure S4. The maximum power density with different pore size (based on electrode mass)

TRAB-0.8 has the highest power density based on the electrode mass because of its smaller electrode mass.

5. The EIS results of TRAB-Cu and TRAB-Cu/C

Table S1 Resistance components of TRAB-Cu and TRAB-Cu/C

Electrode	R_{ohm} (Ω)	R_{ct} (Ω)	R_d(Ω)
TRAB-Cu	2.16	0.37	0.63
TRAB-Cu/C	2.40	0.23	0.43

The EIS results of TRAB-Cu and TRAB-Cu/C is shown in Table S1. The R_{ohm} is the ohmic resistance, which comprises the electrolyte and electrode resistance; and R_{ct} represents the charge-transfer resistance and R_d is linked to the diffusion resistance. The reaction internal resistance (the sum of charge transfer resistance and diffusion resistance) of Cu/C electrode is 0.66 Ω which is lower than that of the copper foam electrode (1 Ω).

6. The resistance components of TRAB with different electrodes

Table S2 Resistance components of TRAB with different electrodes

Pore size	R_{ohm}(Ω)	R_{ct} (Ω)	R_d(Ω)	Total(Ω)	surface area(cm^2)
0.5mm	2.68	0.29	0.89	3.86	37.04
0.6mm	2.40	0.23	0.43	3.06	32.20
0.7mm	2.32	0.39	0.38	3.09	27.69

0.8mm	2.36	0.41	0.40	3.17	24.07
0.9mm	2.57	0.48	0.40	3.45	21.57

The EIS results and surface area of different electrodes is shown in Table S2. The surface area of the electrode decreases with the increase of the pore size. TRAB-0.6 had the smallest internal resistance and obtained the highest performance.