

Supplementary Information

A general route for mass-production of graphene-enhanced carbon composites toward practical pouch lithium-ion capacitors

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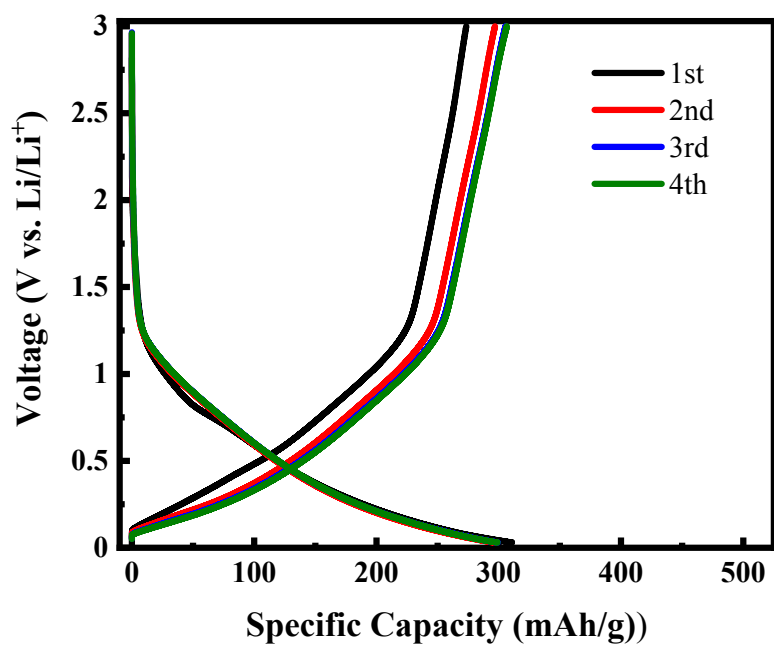


Figure S1. The charge and discharge profiles of pure SC at 0.1 A g^{-1} .

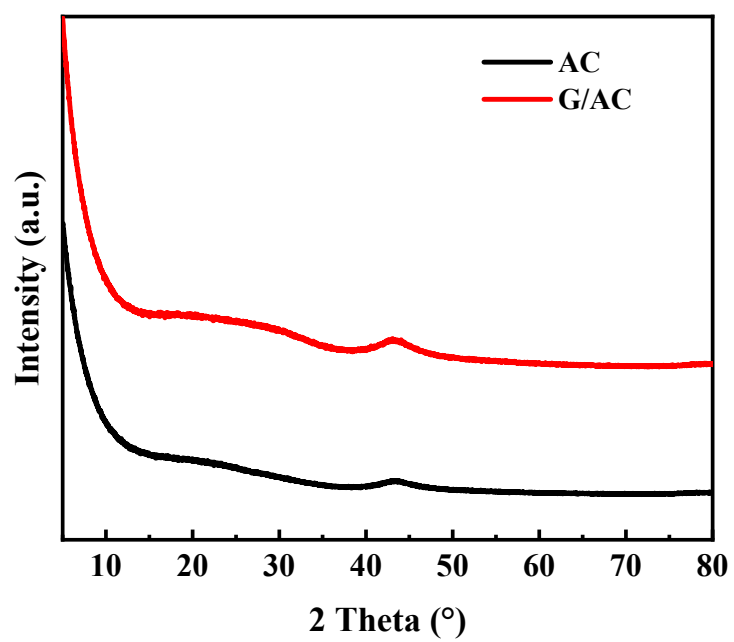


Figure S2. XRD patterns of pure AC and G/AC.



Figure S3. The photograph of 400 g G/SC-2.5% prepared by SHS.

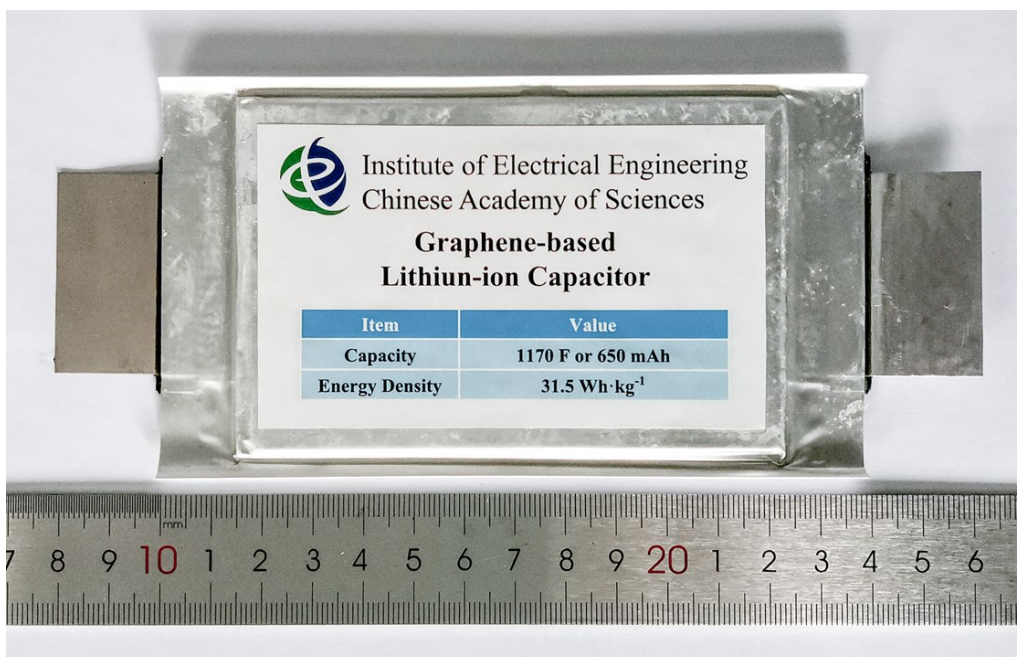


Figure S4. The photograph of the large-capacity LIC pouch cell (G/SC//AC).

Table S1. The fitting results of half-cell equivalent circuit assembled using pure SC and G/SC composites.

	R_0	R_{ct}	Q_{ct}
Pure SC	11.89 Ω	101.7 Ω	1.16E-4 F
G/SC-2.5%	10.92 Ω	69.09 Ω	1.74 E-4 F
G/SC-5%	18.01 Ω	85.74 Ω	2.02 E-4 F

Table S2. The detailed comparison between G/AC//G/SC and other LICs reported in the literature using similar anode and cathode materials.

Cathode material	Anode material	voltage window	Energy density	Cycling performance	Ref.
Nitrogen-doped hierarchical carbon nanolayers (NHCNs)	Mesoporous graphene (SHSG)	2.0-4.5 V	146 Wh kg ⁻¹ at power density of 650 W kg ⁻¹	91% retention after 40,000 cycles	1
Commercial activated carbon (AC)	Petroleum coke (PeC)	0-4.0 V	~ 106.9 Wh kg ⁻¹ at 33 W kg ⁻¹	After a decay (40-50%), the capacity was fully maintained for 50,000 cycles	2
Commercial activated carbons (AC)	Natural graphite	1.5-5.0 V	145 Wh kg ⁻¹ at 0.1 A g ⁻¹	86% retention after 10,000 cycles (4.5V)	3
Hierarchical porous activated carbon derived from sisal fibers (SFAC)	Graphitic carbon derived from sisal fibers (GC)	2.0-4.0 V	104 Wh kg ⁻¹ at 143 W kg ⁻¹	96.5 % at 1 A g ⁻¹ after 3,000 cycles.	4
Activated carbon (AC)	hard carbon (HC)	2.0-3.9 V	82 Wh kg ⁻¹ at 2.4 C	97% retention after 600 cycles	5
Coconut shell derived mesoporous carbon (CS-AC)	Natural plant-derived hard carbon (HC)	1.7-4.2 V	121 Wh kg ⁻¹ at 0.1 A g ⁻¹	83% retention after 8,000 cycles	6
Graphene enhanced active carbon (G/AC)	Graphene enhanced soft carbon (G/SC)	1.0-4.1 V	151 Wh kg ⁻¹ at 241 W kg ⁻¹	90% capacity retention after 10,000 cycles	This work

Table S3. The detailed information of LIC pouch cell made of G/SC and AC.

Active material	G/SC-2.5% (anode)	AC (cathode)
Proportion of active materials	90%	87%
Mass loading	8.68 mg/cm ²	12.62 mg/cm ²
Coating thickness	85 μm	235 μm
Compacted density	1.02 mg/cm ³	0.537 mg/cm ³
Current collector	8 μm Cu with 2 μm coating	20 μm Al with 2 μm coating
Electrode size	70 × 105 mm	67 × 102 mm
Number of electrodes	16 PCS	15 PCS
Separator	30μm cellulose membrane	
Discharge Capacity	650 mAh or 1170 F	
Discharge energy	1.97 Wh	
Total mass	62.5 g	
Internal resistance (at 1 kHz)	4 mΩ	
Energy density (at 1 C)	31.5 Wh/kg	
Power density (at 200 C)	5.01 kW/kg	

References

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Supporting Video

Video S1. LIC pouch cell power an electric car model for 84 minutes on a single charge.

Video S2. LIC pouch cell is charged to 4 V within tens of seconds at 100 C.