

Supporting Information

Lithium-Ion Capacitor with Improved Energy Density via Perfect Matching Silicon@3D Graphene Aerogel Anode and BCNNTs Cathode

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Results and Discussion

(Supplementary Figures S1–S11, Table S1 and S2)

Table S1. Comparison of the electrochemical properties of BCN cathode with other carbon-based cathodic materials.

Cathode	Current density /mA g ⁻¹	Cycles	Specific Capacity /mAh g ⁻¹	Reference
TR-GO	100	1000	44	<i>ChemSusChem</i> 2013 , 6, 2240 – 2244
Amorphous carbon-graphite	75	1000	48	<i>Journal of Materials Science&Technology</i> 2018 ,34,983–989
BCNNTs	100	200	108.8	This work

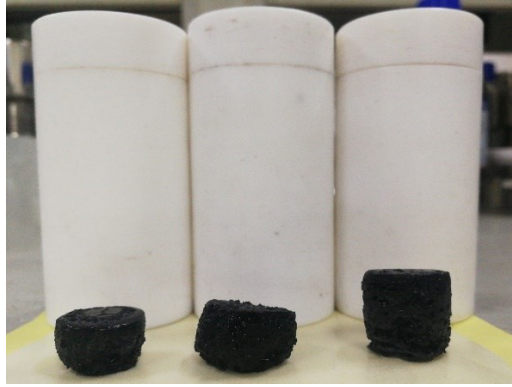


Figure S1. The photographs of SiO₂@GA hybrid architectures prepared with 10 mL, 15 mL and 20 mL graphene (from left to right) after freeze-dried treatment.

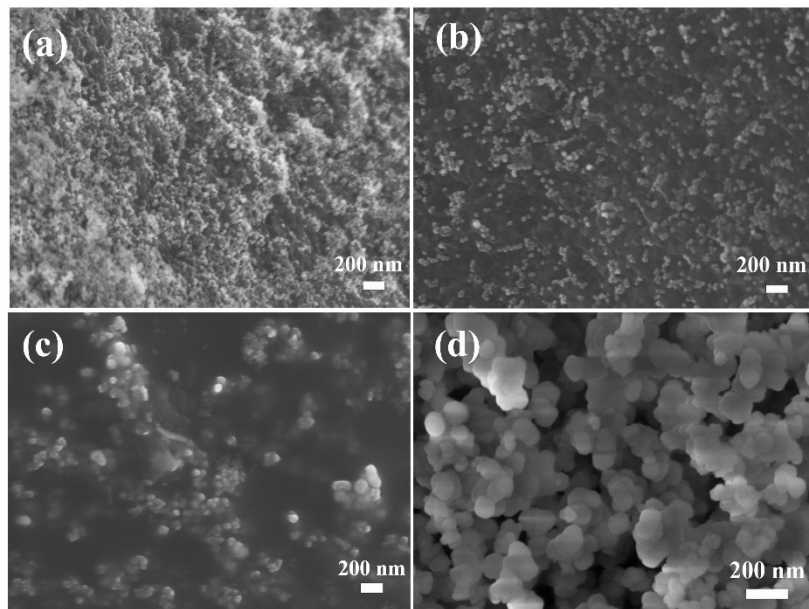


Figure S2. SEM image of Si@GA-1 sample (a), Si@GA-2 sample (b), Si@GA-3 (c) and pure Si samples (d).

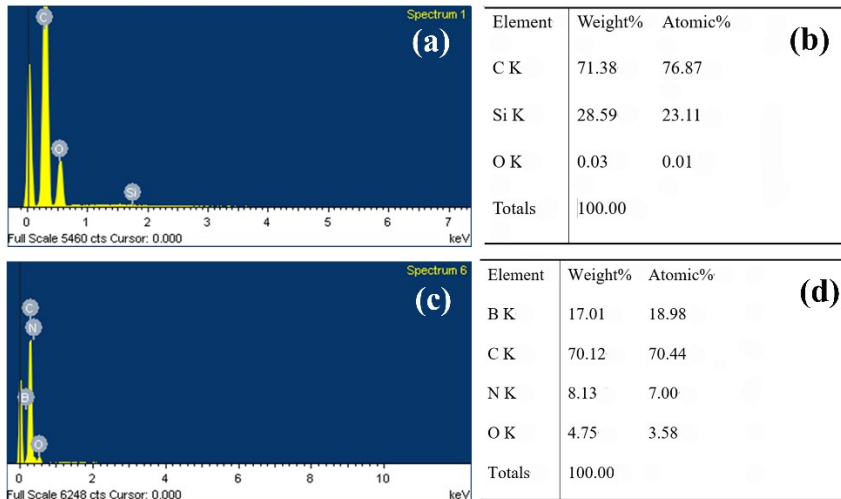


Figure S3. EDX analysis and related element contents of Si@GA-2 anode (a-b) and BCNNTs cathode (c-d).

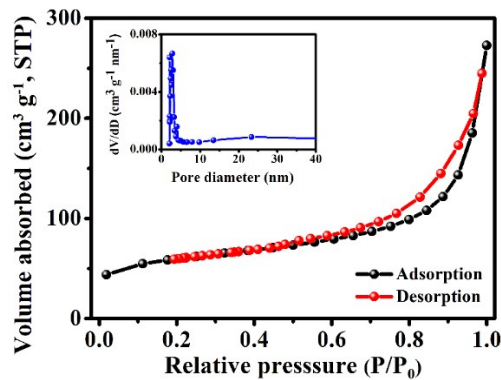


Figure S4. Nitrogen adsorption-desorption isotherm and the corresponding pore size distribution curve (inset) of BCNNTs cathode.

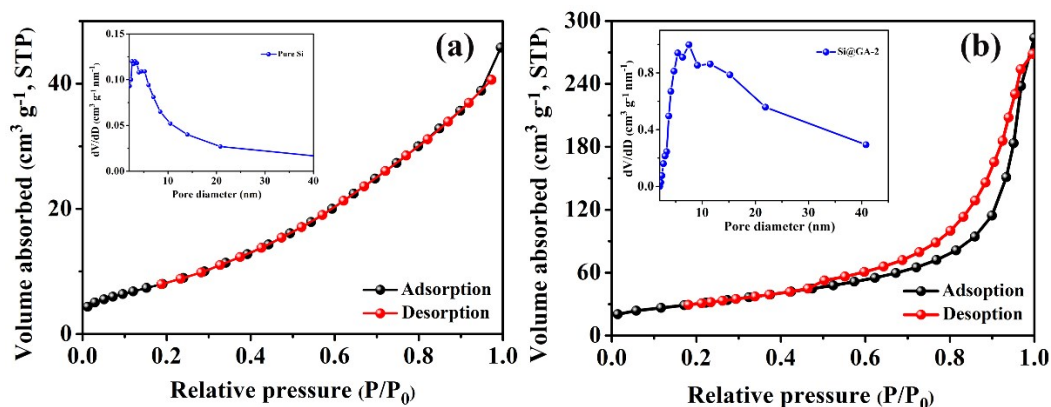


Figure S5. Nitrogen adsorption-desorption isotherm and the corresponding pore size distribution curve (inset) of pure Si (a) and Si@GA-2 anode (b).

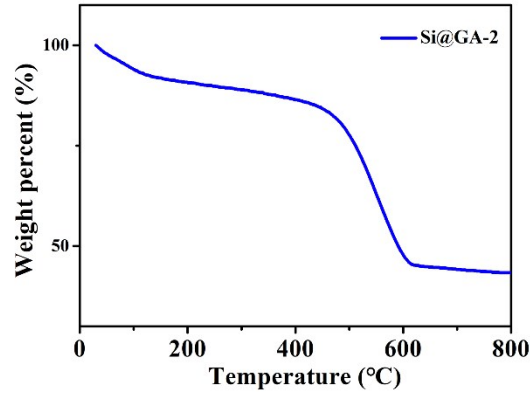


Figure S6. TG curve of Si@GA-2 anode.

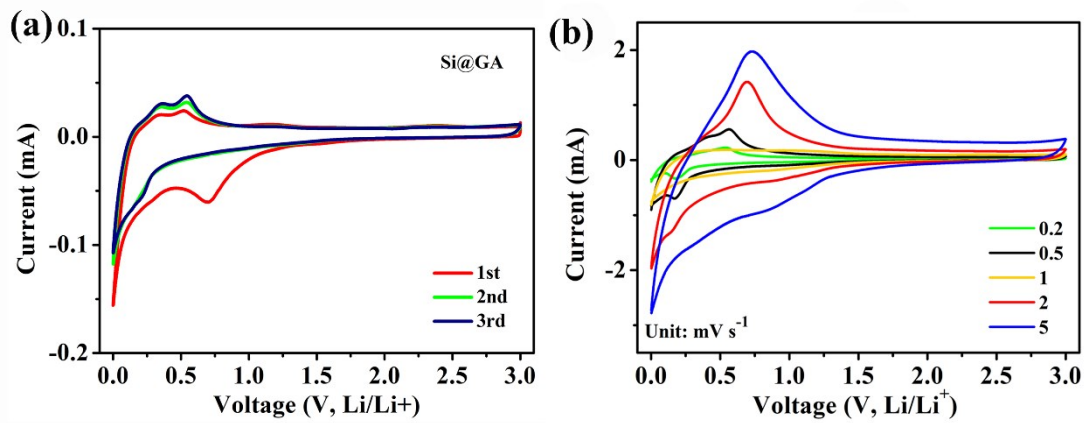


Figure S7. CV curves of Si@GA-2 anode for the initial 1st, 2nd, 3rd cycles at 0.1 mV s⁻¹ between 0.01 and 3.0 V (vs Li/Li⁺) (a). CV curves of Si@GA anode at various scan rates between 0.01 and 3.0 V (vs Li/Li⁺) (b).

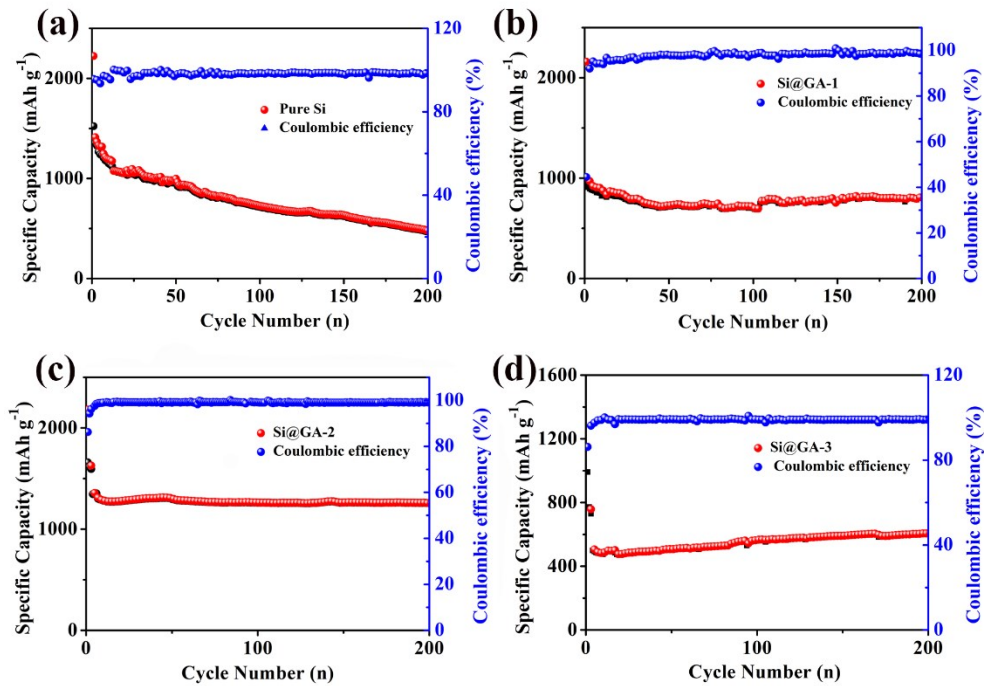


Figure S8. Cycling performances of pure Si anode (a), Si@GA-1 (b), Si@GA-2 (c) and Si@GA-3 (d) at a current density of 0.1 A g^{-1} between 3.0-0.01 V versus Li^+/Li .

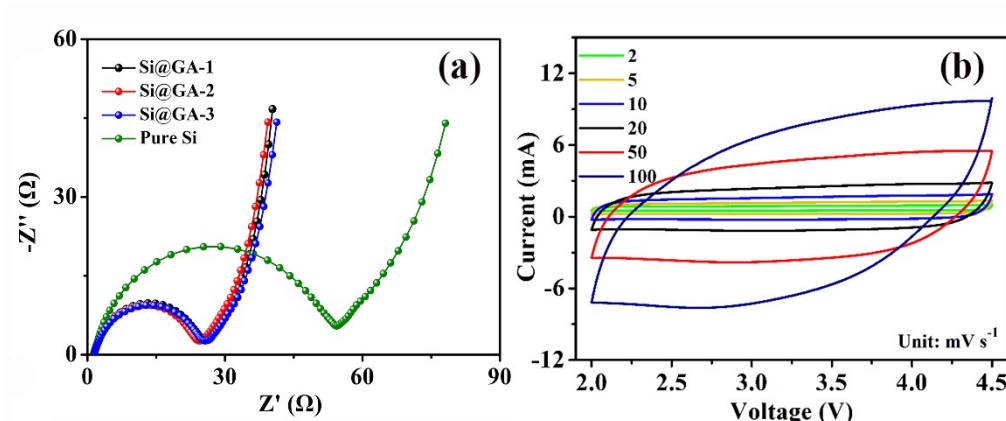


Figure S9. (a) Nyquist plots of pure Si and Si@GA electrodes with different graphene contents. (b) CV curves of BCNNTs cathode at different scan rates from 2 mV s^{-1} to 100 mV s^{-1} between 2.0 and 4.5 V (vs Li/Li^+).

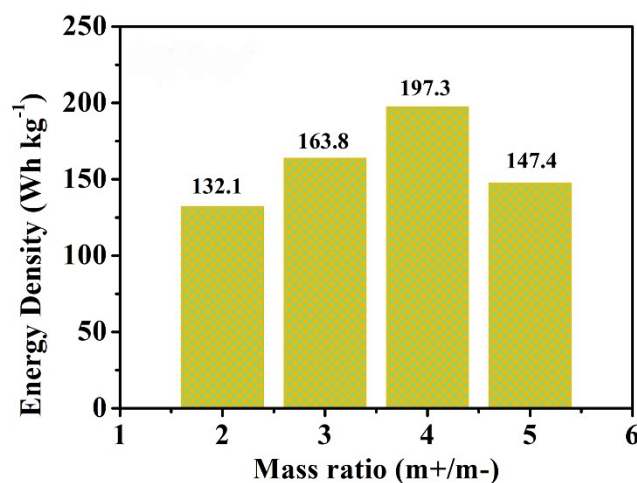


Figure S10. Energy densities of Si@GA/BCNNTs LIC with different mass ratios of cathode vs. anode materials under the same scan rate. (The energy density is 197.3 Wh kg^{-1} based on the total mass of cathodic and anodic active materials for the optimized ratio of 4:1)

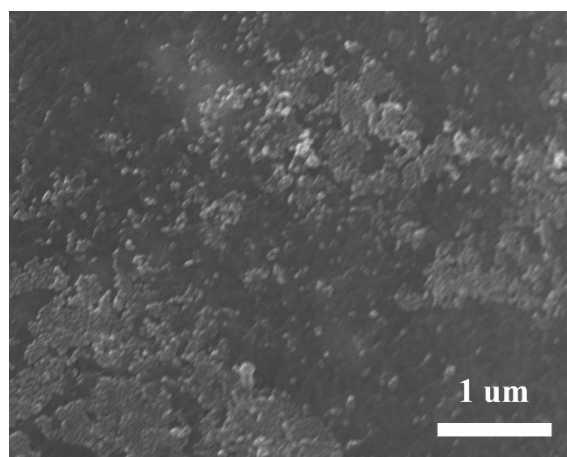


Figure S11. SEM image of Si@GA anode after 10000 cycles.

Table S2. Electrochemical performance of different anode electrodes and the relevant LICs.

LICs	Max energy density (Wh kg ⁻¹)	Power density (W kg ⁻¹)	Voltage (V)	Ref.
B-Si/SiO ₂ /C//PSC	128	9704	2-4.5	[8]
AC//LiNi _{0.5} Mn _{1.5} O ₄	56	600	1-3	[9]
Fe ₃ O ₄ /granphene//3D-graphene	147	150	1-4	[10]
Graphene-NiCo//AC	19.5	5600	0-1.4	[13]
VN/RGO//APDC	30	220	1-2.8	[14]
SnO ₂ /RGO//AC	140	142	0-2.7	[44]

LiNbO ₃ /GA//BCN	148	200	0-4	[45]
Li ₄ Ti ₅ O ₁₂ //AC	50	2500	1-3	[46]
Li-HC//CS-AC	121	---	1.7-4.2	[47]
Mn ₃ O ₄ -G//AC	142	648	1.5-4	[48]
LiC ₆ //AC-HBP	111	---	2-3.9	[49]
HDMPC HDMPC	106.4	500	1-4	[51]
Si@GA//BCNNTs	197.3	225	0-4.5	This work

(max: 11200)
