



Supplemental Materials

Interfacial Stabilization of a Graphene-Wrapped
Cu₂S Anode for High-Performance Sodium-Ion
Batteries via Atomic Layer Deposition

Jiyu Cai, Zonghai Chen, and Xiangbo Meng

Table S1. Summary of electrode loading and battery performance in all previously reported literatures and this study†

Materials (Composite)	Active loading (%)	Voltage (V)/ Current Density (mA·g ⁻¹)	Cu ₂ S Capacity (mAh·g ⁻¹)	CE/Cycles	Electrode Capacity (mAh·g ⁻¹)	Ref.
Cu ₂ S	60.0	0.4–2.6/50	220	~100%/20	132	[1]
Cu ₂ S	80.0	0.2–2.5/337	270	~100%/400	216	[2]
Cu ₂ S@NSC	51.5	0.01–3/100	182.3	~100%/50	93.9	[3]
Cu ₂ S@C	70.0	0.01–2.5/5000	290	~100%/5000	203	[4]
Cu ₉ S ₅ @NSC	48.2	0.01–3.0/100	344.3	~100%/200	166	[5]
Cu ₉ S ₅ @NC	65.0	0.4–2.6/300	300	99%/500	194.9	[6]
Cu ₉ S ₅ -AHP (S impurity)	62.2	0.3–3.2/100	386	94.3%/200	239.9	[7]
Cu _{1.8} S	80.0	0.5–2.2/84	250	~100%/1000	200	[8]
Cu ₂ S@NG	80	0.2–3.0/100	314	99.9%/1000	252	[9]
ALD- Cu ₂ S@NG	80	0.01–3.0/100	374	99.9%/100	300	This work

† Our electrodes show the highest electrode capacity, regarding to the active material loading.

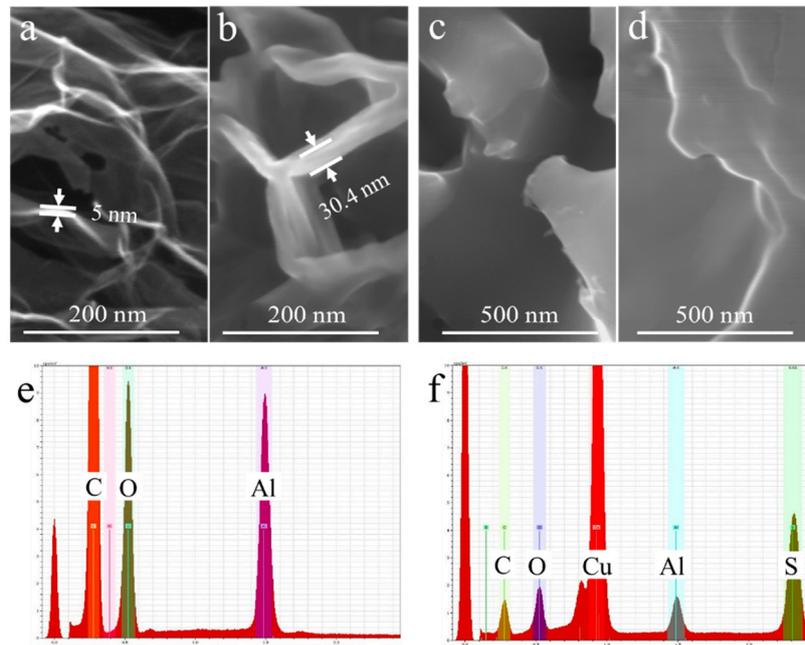


Figure S1. High-magnification SEM images of (a) bare and (b) Al₂O₃-coated (80 cycles) NG and (c) bare and (d) Al₂O₃-coated (80 cycles) Cu₂S demonstrate the uniformity and conformity of ALD coating on electrode materials. EDX element mapping of Al₂O₃-coated (e) NG and (f) Cu₂S reveals the content of Al as Al₂O₃ coating.

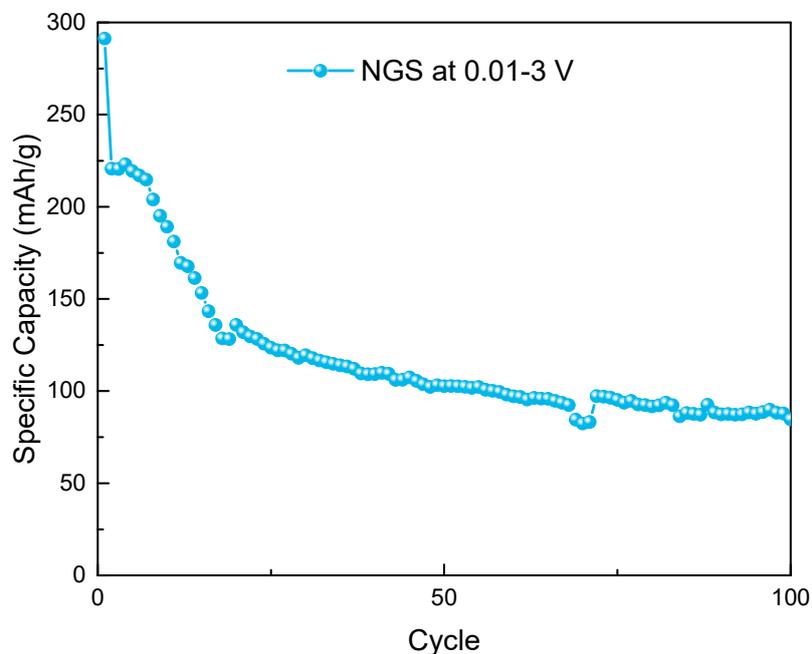


Figure S2. Cycling performance of a Na-NG half-cell, delivering 84 mAh g⁻¹ capacity at 100th cycle.

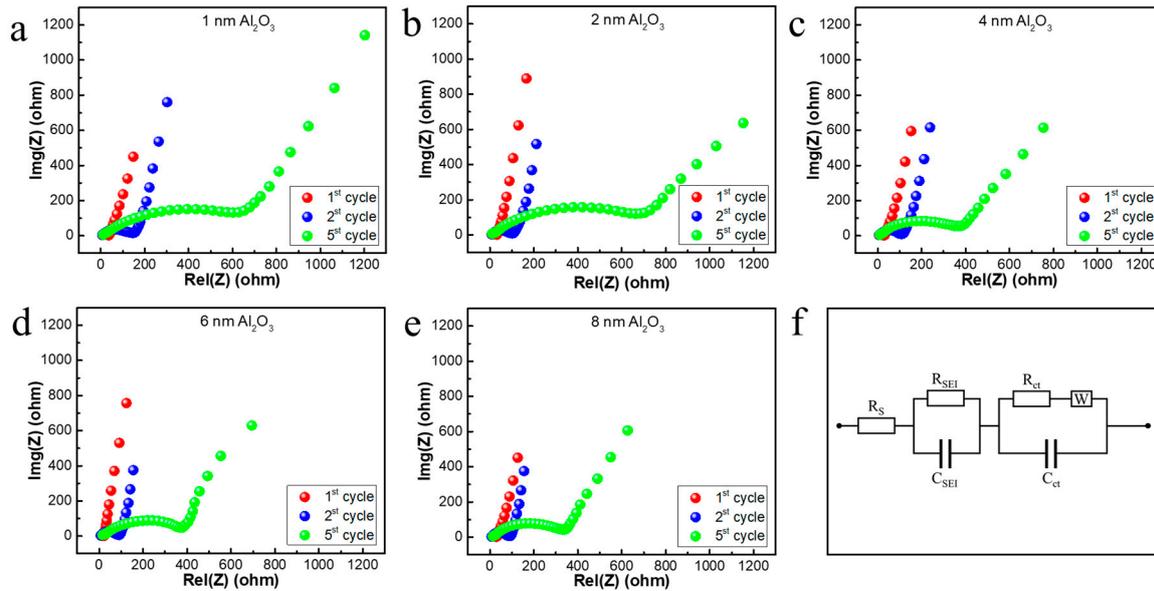


Figure S3. Nyquist plots from EIS measurements of ALD-coated Cu₂S@NG electrodes with (a) 1, (b) 2, (c) 4, (d) 6, and (e) 8 nm Al₂O₃ coating during 5 cycles. (f) The physical model used for fitting EIS data.

Table S2. The fitted EIS data for Cu₂S@NG and ALD-coated Cu₂S@NG at 0.01–3 V

Electrode	Cycle #	R _s (ohm)	R _{SEI} (ohm)	R _{ct} (ohm)	C _{SEI} (F)	C _{ct} (F)
Cu ₂ S@NG	1	6.896	21.54	3.132	7.33E-07	7.42E-05
	2	5.948	177.4	18.56	4.18E-06	0.01408
	5	6.269	1017	89.01	2.21E-05	0.02195
ALD-coated (6 nm Al ₂ O ₃) Cu ₂ S@NG	1	5.202	14.54	1.454	1.015E-6	0.01569
	2	4.366	81.11	21.48	1.945E-6	0.03081
	5	4.702	420	116.5	3.372e-5	0.02195

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