Supporting Information

Aluminum Dendrites Suppression by Graphite Coated Anode of Al-Metal Battery

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Table S1. The electrochemical performances of the state-of-the-art Al anodes and Al-g anode in ILs based electrolyte.

Electrode	Cell type	Overpotential (mV)	Current density (mA cm^{-2})	Cycling	CEs	Ref
3D Al anode	Symmetric	170	0.5	450 hours	/	1
Biomimetic scaffold	Asymmetric	81	1	1400 cycles	~99.27 (45th cycle)	2
3D thin film	Symmetric	54	0.3	/	/	3
Pyrolytic carbon nanotube forest	Symmetric	~50	0.5	1000 hours	/	4
Porous Al	Symmetric	~180	3	100 hours	/	5
Nanoporous carbon	Symmetric	~65	1	1000 hours	/	6
Au nanosheets	Asymmetric	~100	1	500 cycles	~96% (10th cycle); ~99.2% (300th cycle)	7
N doped carbon rod array	Symmetric	~50	0.5	240 hours	/	8
Pt ultrathin aluminophilic interface layer	Asymmetric	109.4	1	550 hours	~98.6% (10th cycle); ~99.6% (100th cycle)	9
Graphite coating Al	Symmetric	43	0.4	400 hours	/	This work
	Asymmetric	35	0.4	250 cycles	~95.7% (10th cycle) ~99.4% (200th cycle)	

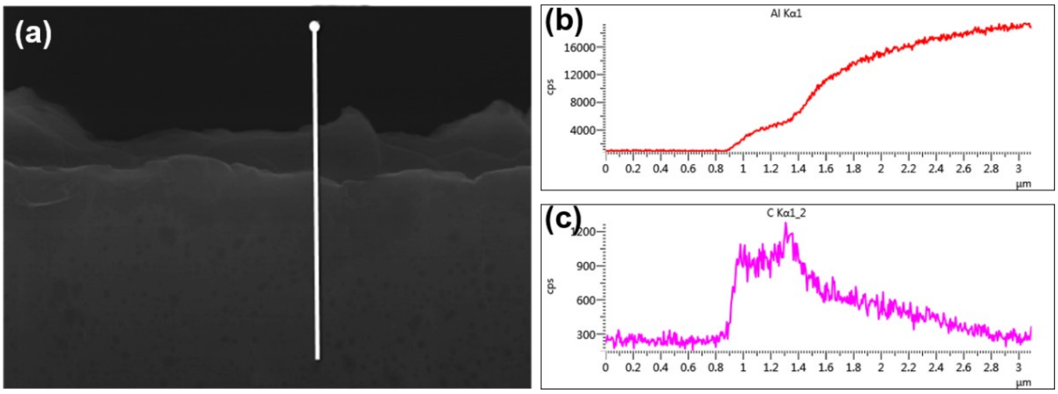

Figure S1. EDS line scan of Al-g. (a) The cross viewed SEM image. (b and c) Intensities of Al (b) and C (c) along the arrow in (a).

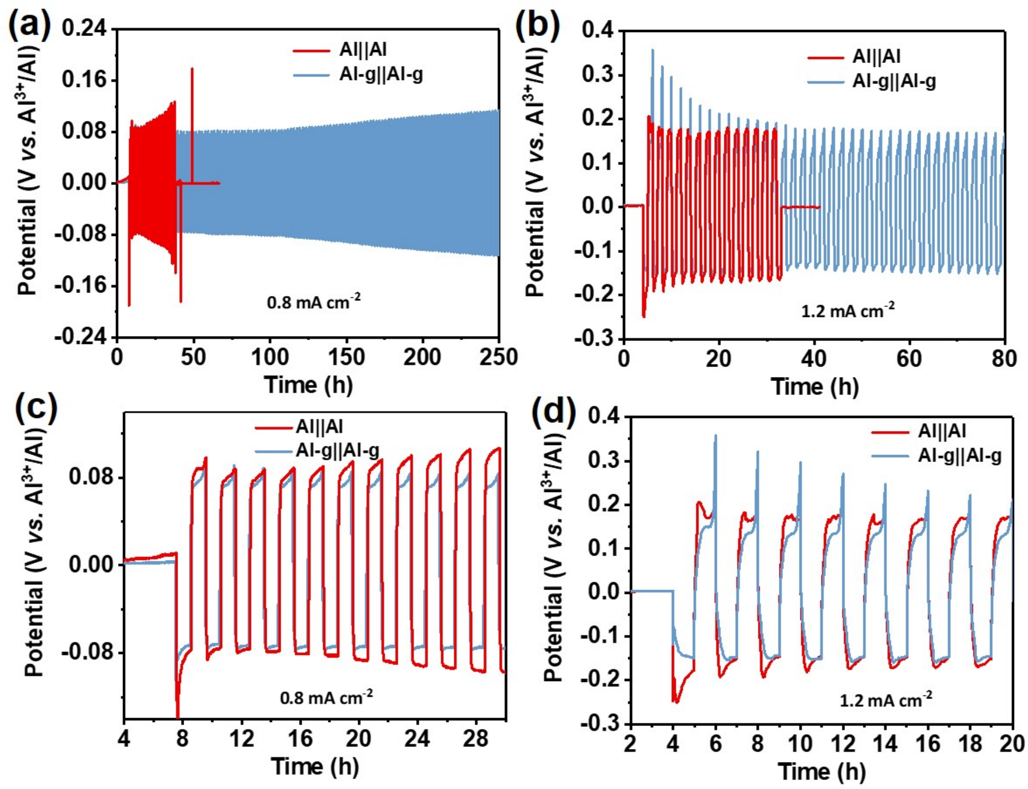

Figure S2. (a and b) Electrochemical cycling performances of symmetric Al||Al and Al-g||Al-g cells at (a) 0.8 and (b) 1.2 mA cm cm^{-2}. The Al plating/stripping processes maintained at 1 h. (c) Magnified profile of (a). (d) Magnified profile of (b).

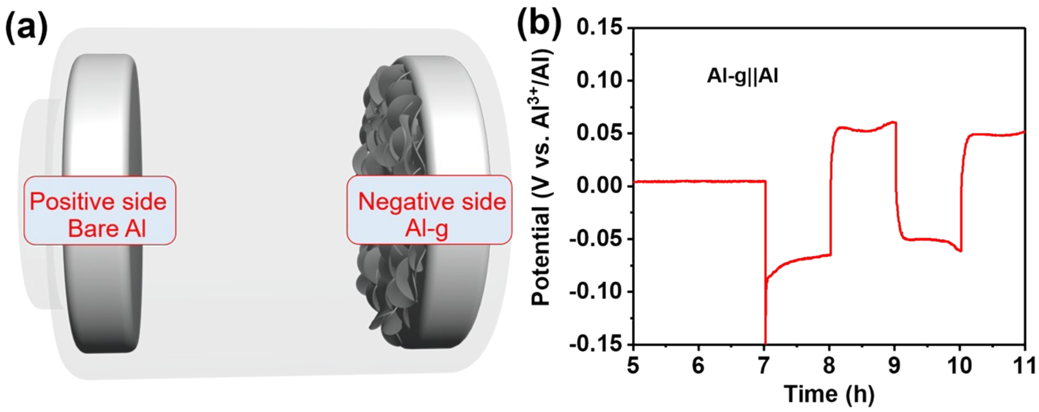

Figure S3. (a) Schematic illustration of Al-g||Al configuration and (b) the corresponding voltage-time profile.

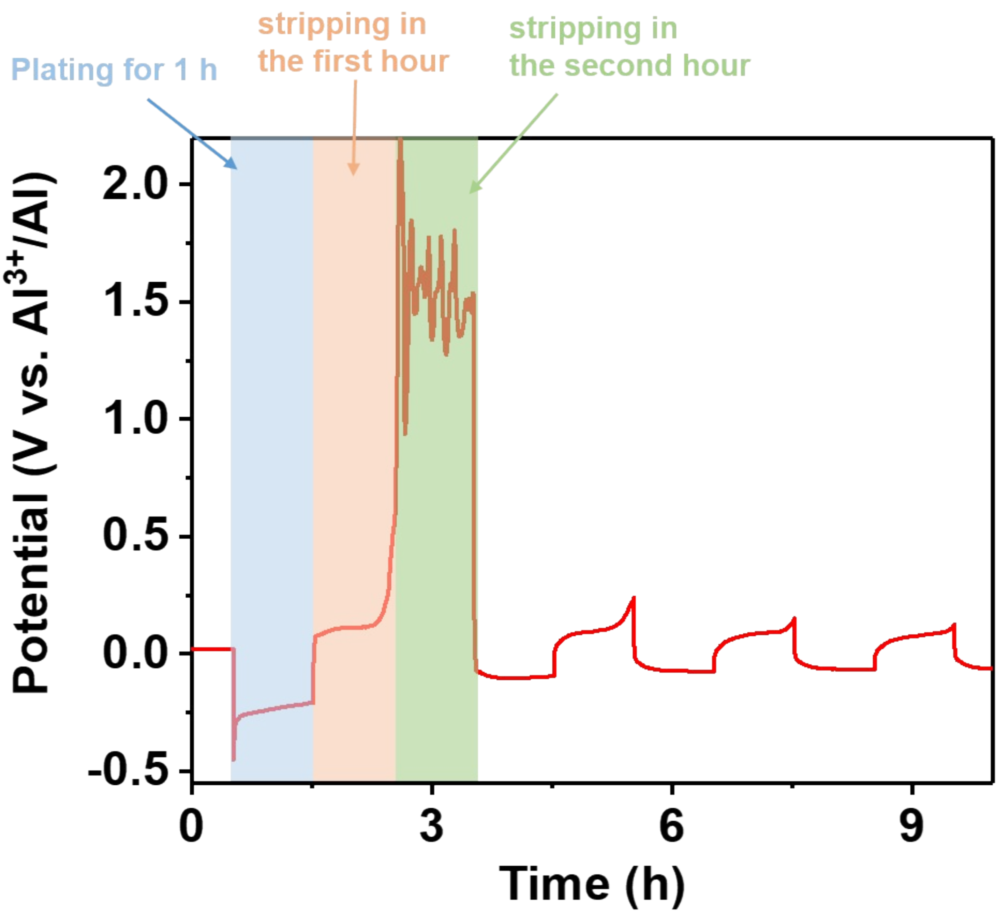

Figure S4. The voltage-time profile of Al||Al-g cell with negative bias for 1 h and positive bias for 2 h in the first cycle.

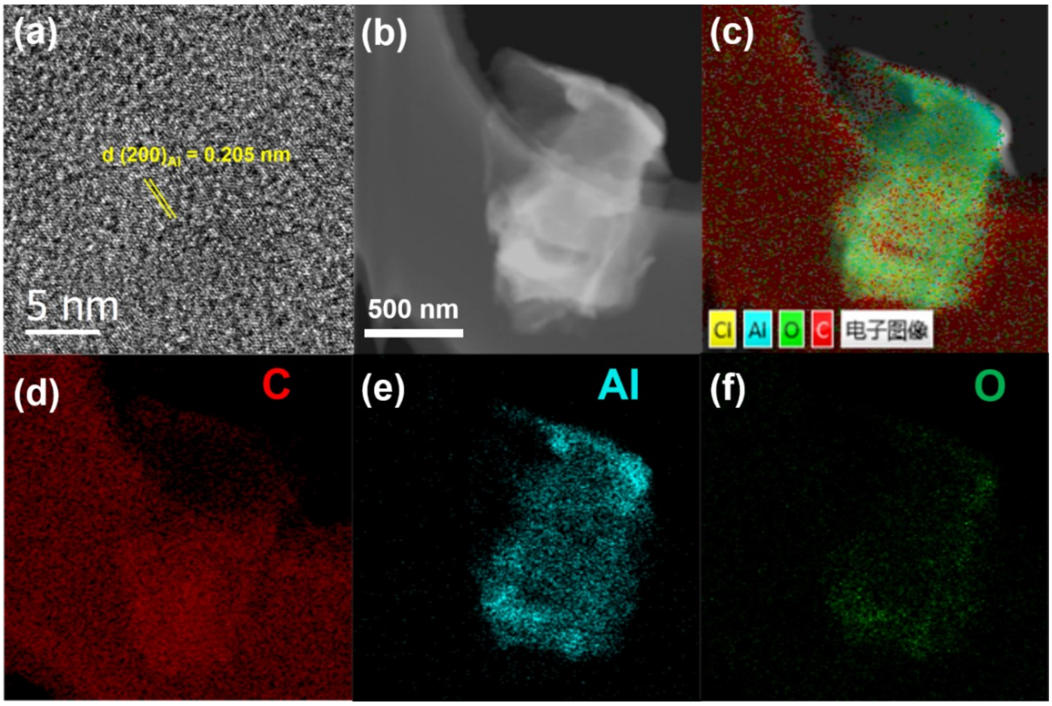

Figure S5. (a) High resolution TEM image, and (b) STEM image of the cycled Al-g. (c-f) EDS mapping of the cycled Al-g.

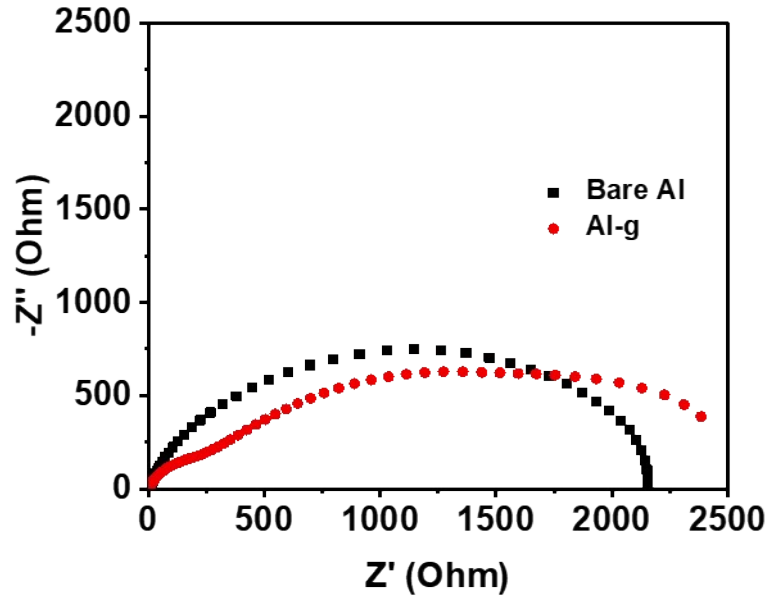

Figure S6. EIS of the symmetric cell with bare Al and Al-g electrodes.

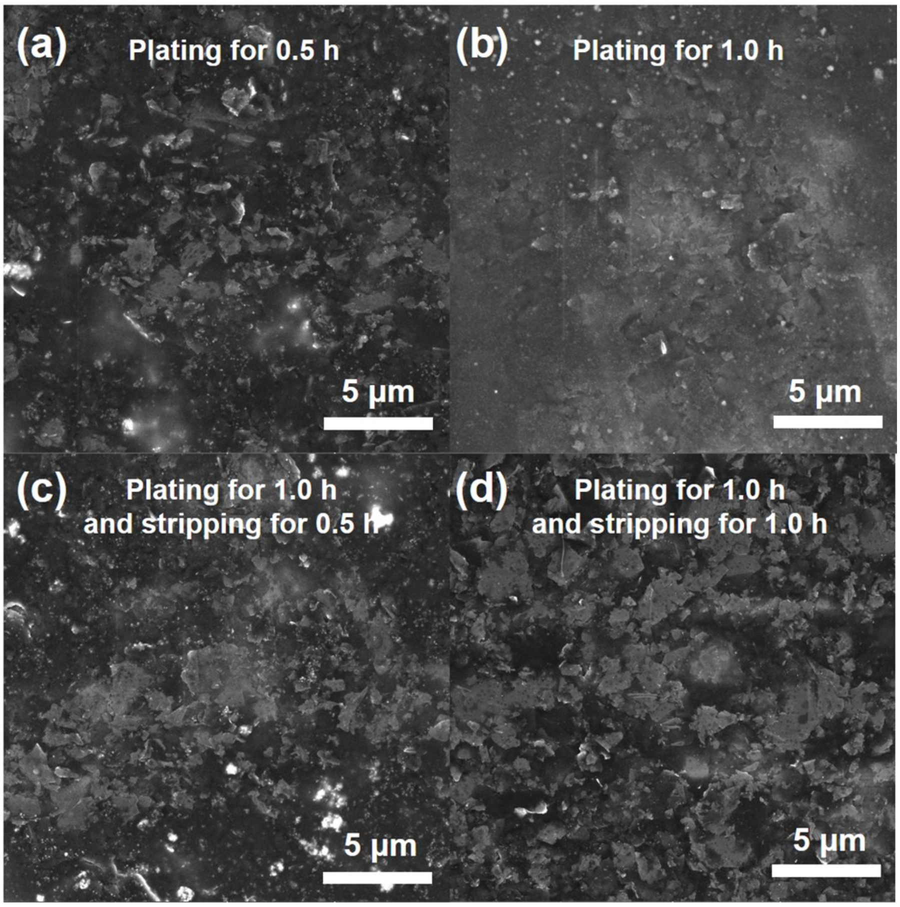

Figure S7. SEM images of the Al-g electrodes after (a) plating for 0.5 h, (b) plating for 1.0 h, (c) plating for 1.0 h and stripping for 0.5 h, and (d) plating for 1.0 h and stripping for 1.0 h.

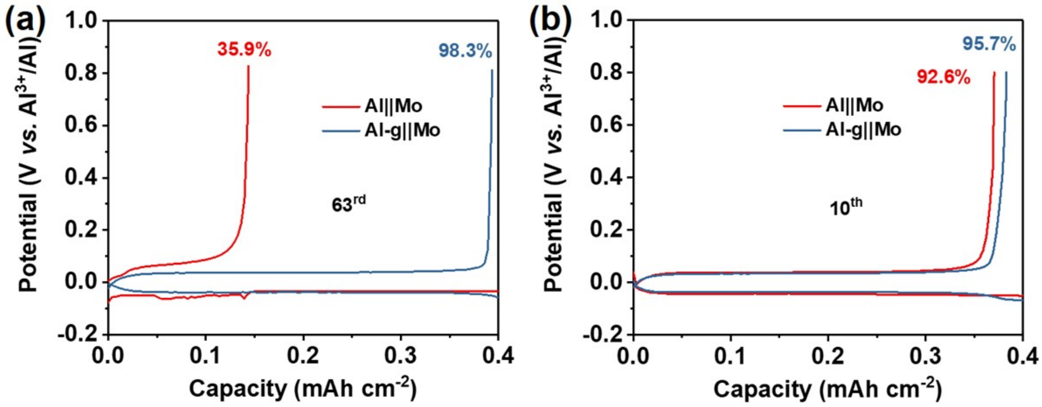

Figure S8. Al plating/stripping voltage profiles from (a) the 63rd and (b) the10th cycle shown for the Al-g anode and bare Al anode at 0.4 mA cm^{-2}.

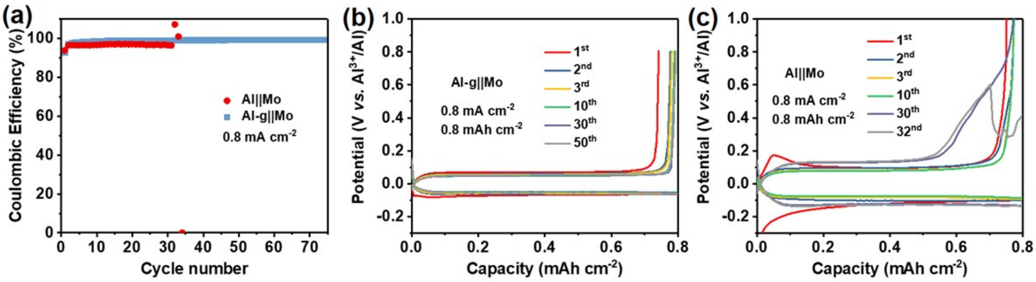

Figure S9. (a) CEs comparison of Al plating on Mo mesh at 0.8 mA cm^{-2}. The amount of plated Al in each cycle is 0.8 mAh cm^{-2}. (b and c) Voltage profiles of the Al plating/stripping process of cells with (b) Al-g anode and (c) Al anode at 0.8 mA cm^{-2}.

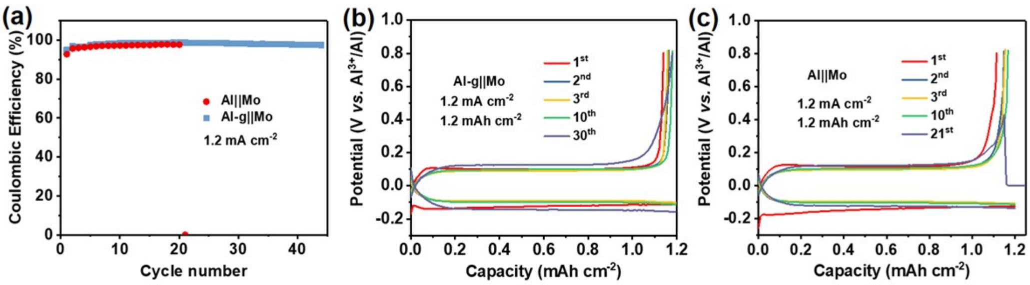

Figure S10. (a) CEs comparison of Al plating on Mo mesh at 1.2 mA cm^{-2}. The amount of plated Al in each cycle is 1.2 mAh cm^{-2}. (b and c) Voltage profiles of the Al plating/stripping process of cells with (b) Al-g anode and (c) Al anode at 1.2 mA cm^{-2}.

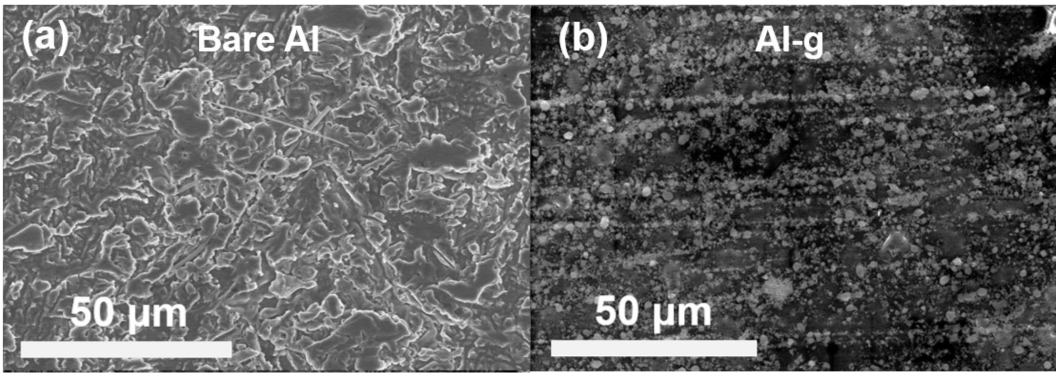

Figure S11. Low-magnification SEM images of (a) bare Al and (b) Al-g electrode after cycling in the corresponding symmetric cells.

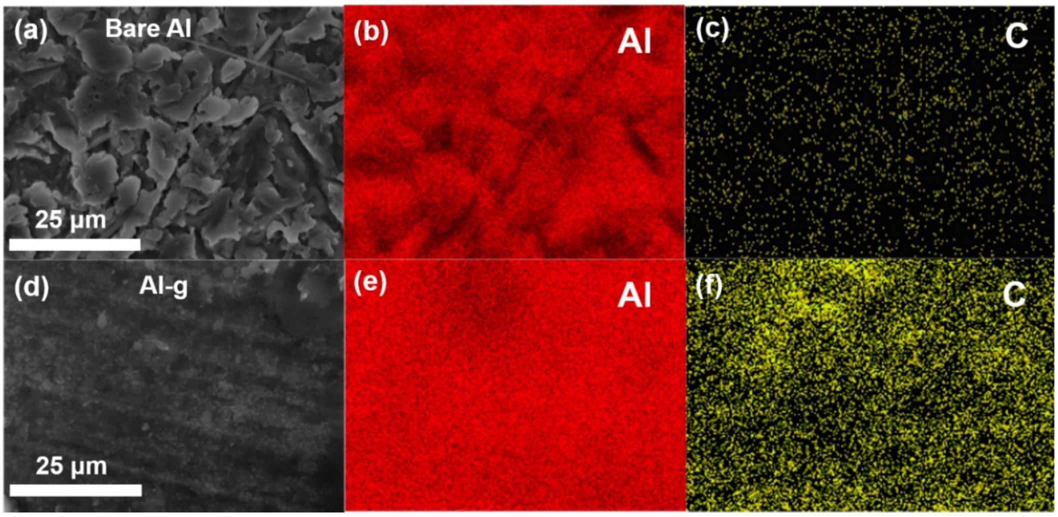

Figure S12. SEM images and corresponding EDS maps of cycled (a-c) bare Al and (d-f) Al-g in the corresponding symmetric cells.

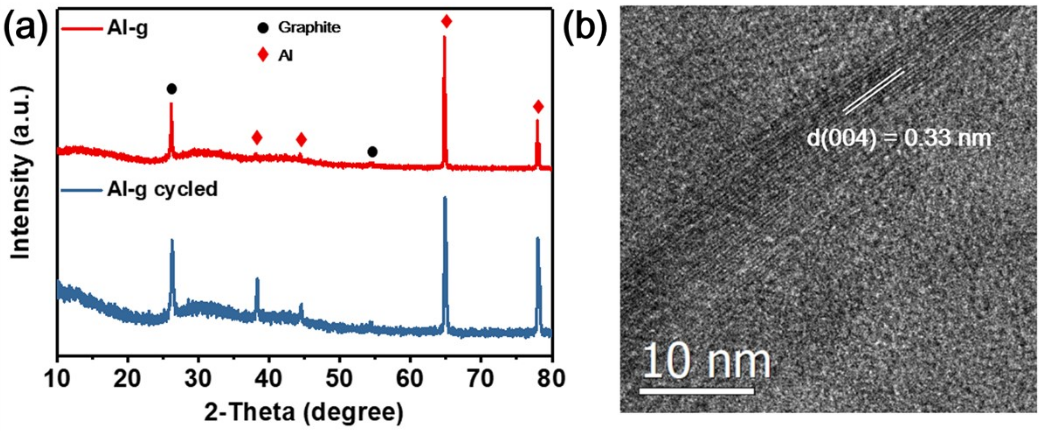

Figure S13. (a) XRD patterns of Al-g electrode before and after cycling. (b) HRTEM image of the Al-g electrode after cycling in symmetric cell.

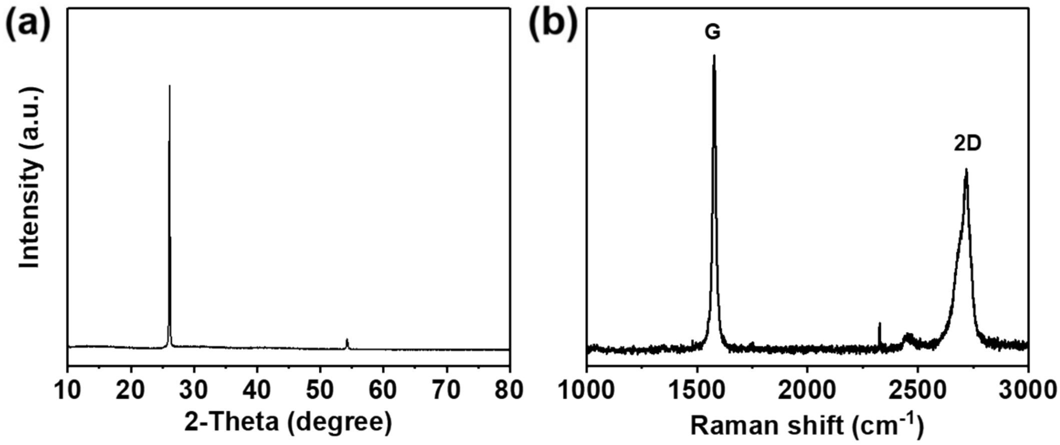

Figure S14. (a) XRD pattern and (b) Raman spectrum of the graphite cathode materials.

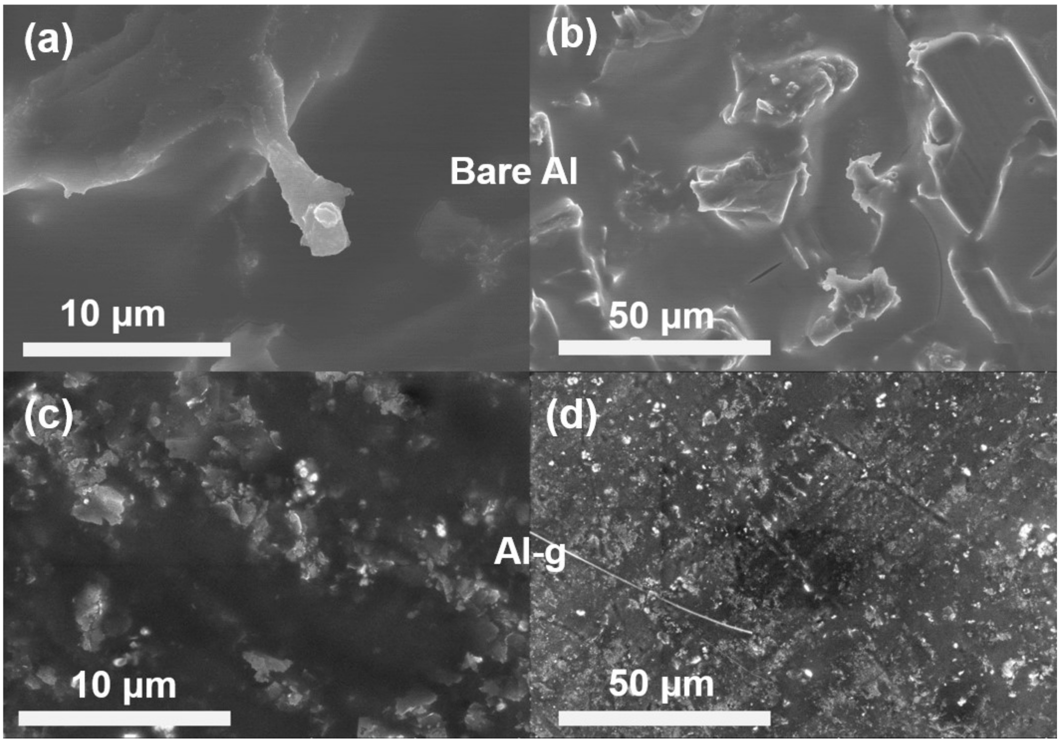

Figure S15. (a and c) Low-magnification and (b and d) high-magnification SEM images of (a and b) bare Al and (c and d) Al-g electrode after cycling in the corresponding Al||graphite and Al-g||graphite batteries.

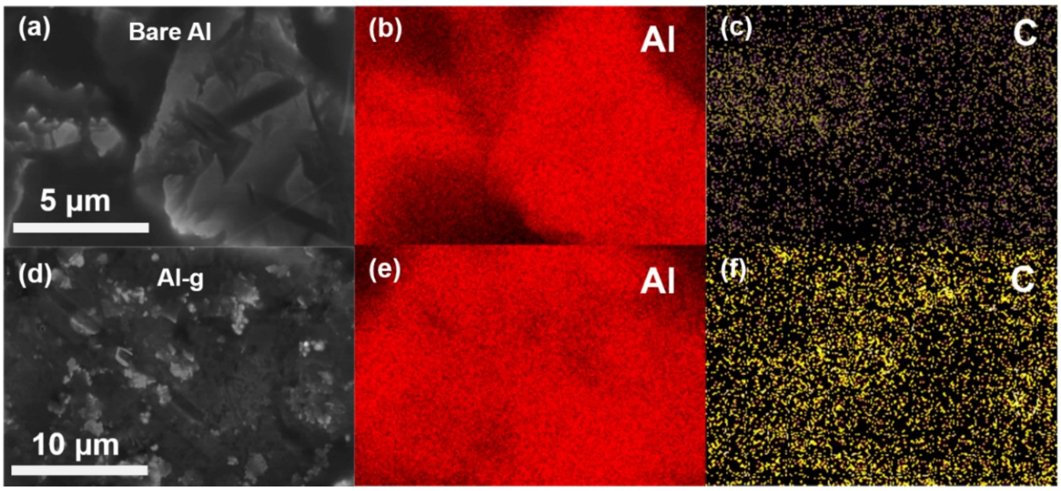

Figure S16. SEM images and corresponding EDS maps of cycled (a-c) bare Al and (d-f) Al-g from Al||graphite and Al-g||graphite dual-ion batteries, respectively.

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