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Supporting Information for

Performance enhancement of graphene-sulfur composite in lithium-sulfur battery by coating an ultrathin Al_2O_3 film via atomic layer deposition

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1. Thermal atomic layer deposition (ALD) of Al_2O_3 onto G-S composites

Al_2O_3 ultrathin films were deposited on G-S composites by thermal atomic layer deposition (ALD, SUNALE R200, Picosun) with different ALD cycles (5 or 10). Typically, the pellets of G-S omposite were placed in the ALD chamber where trimethyaluminium ($Al(CH_3)_3$, 99.9999%, Jiangsu Nata Opto-electronic Material Co. Ltd) reacted with high performance liquid chromatography (HPLC) grade H_2O to form Al_2O_3. In this case, $Al(CH_3)_3$ and H_2O were acted as Al and O element sources. The operational pressure of the system was maintained at about 1800-2000 Pa throughout the deposition. Vapors of the two precursors were alternately carried by N_2 gas into the reaction chamber and the temperature was kept at 120°C. The total deposition time was less than 5 min and the electrode was taken out of the

chamber immediately to avoid the further sublimation of sulfur. The thickness growth of Al_2O_3 layer in each ALD cycle was 1.0-2.0 Å.

2. Supplementary Figures

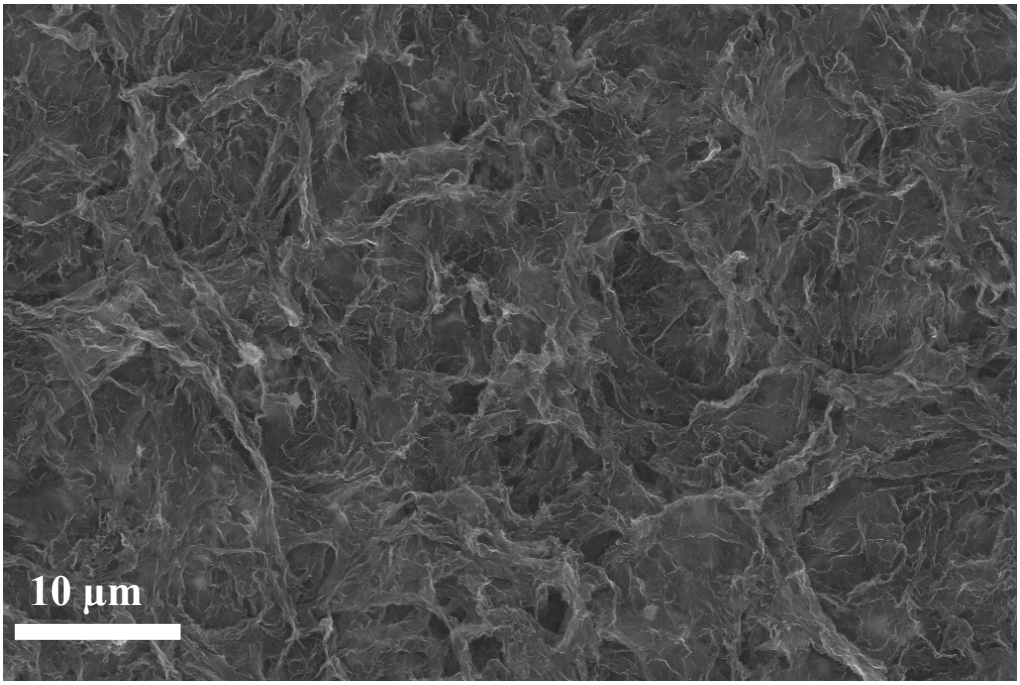

Fig.S1 SEM image of G-S composite.

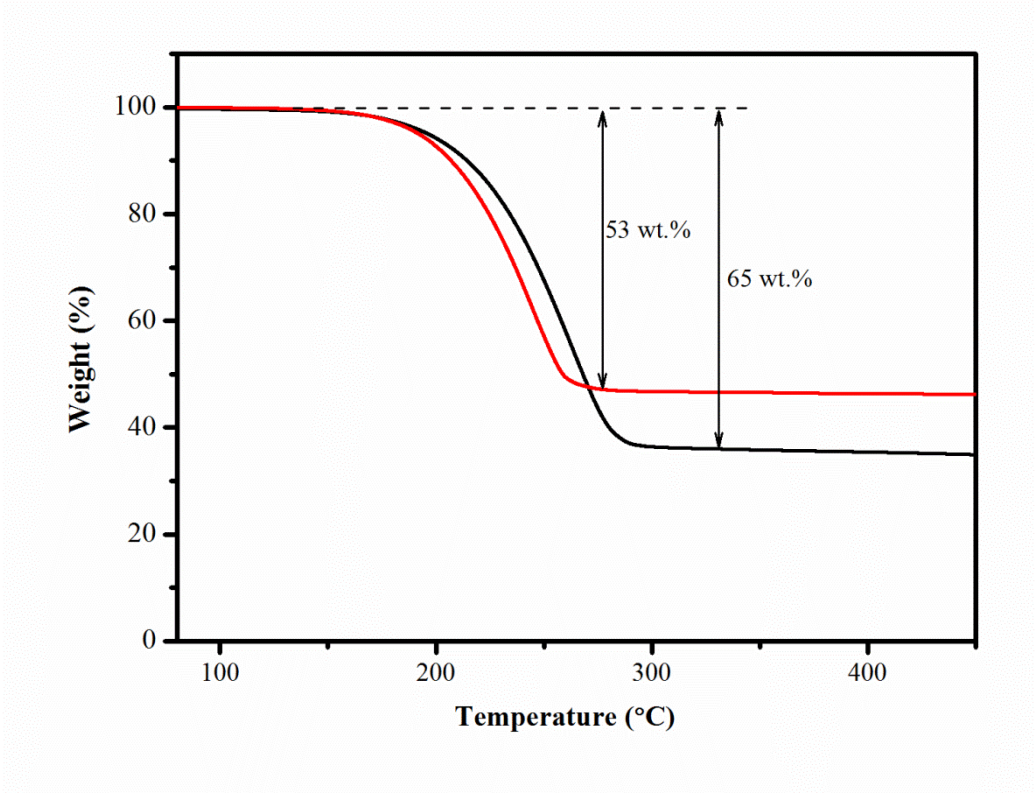

Fig. S2 Thermogravimetric curves of the G-S composite before and after Al_2O_3 coating for 10 ALD cycles.

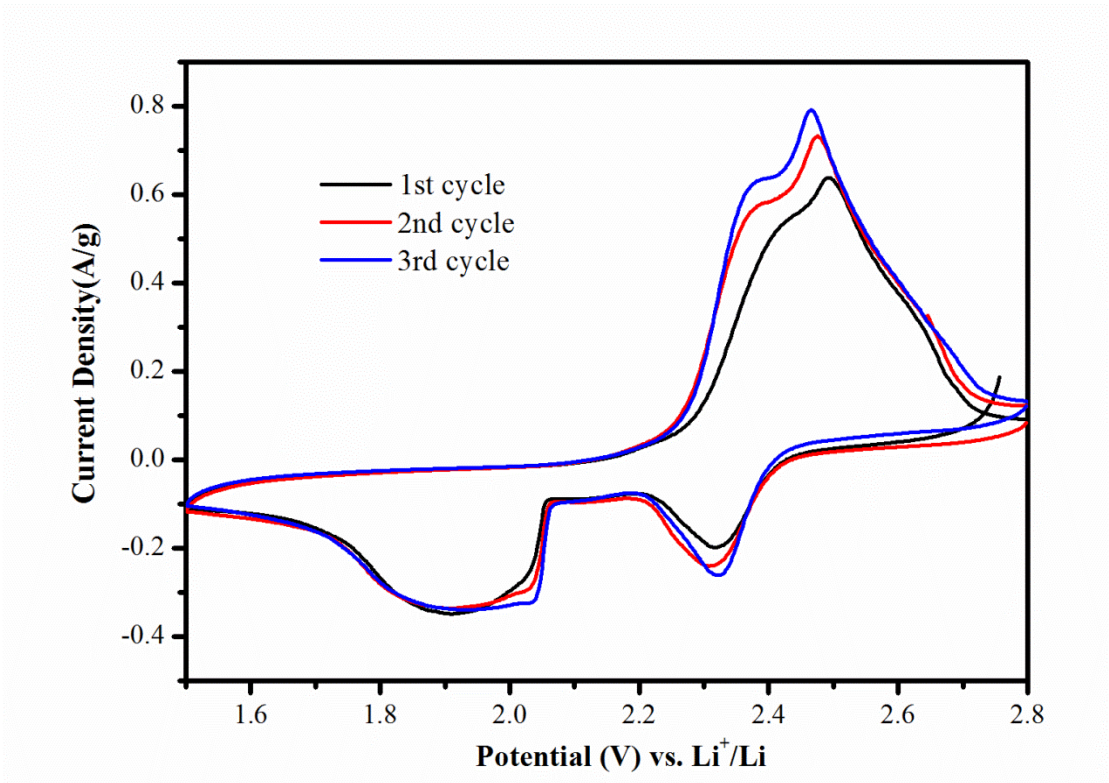

Fig. S3 CV profiles of bare G-S composite electrode at a scan rate of 0.1 mV s^{-1}.

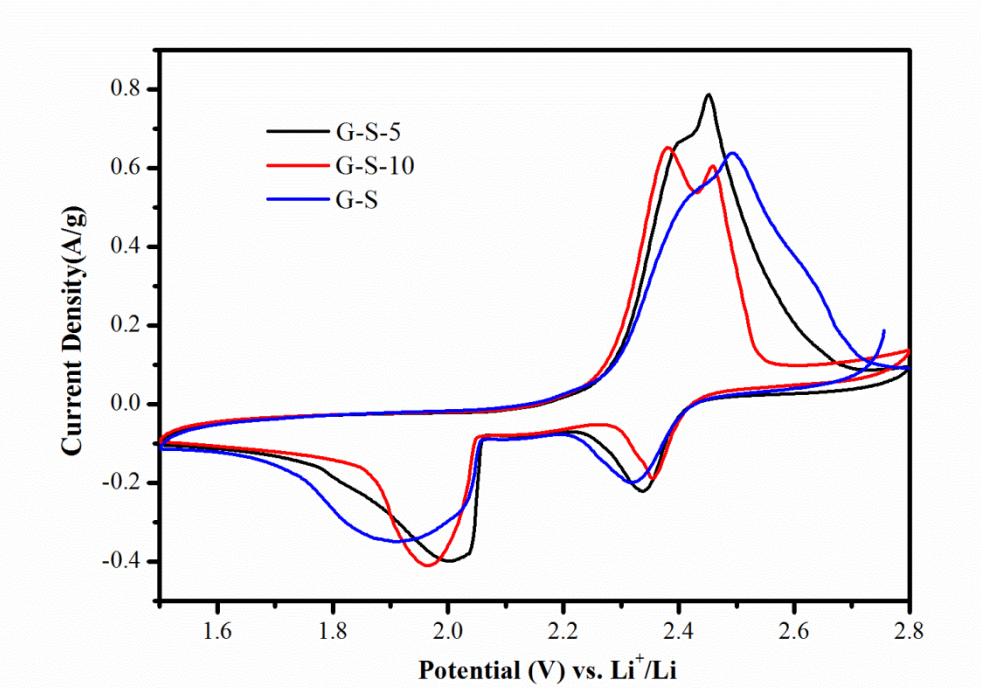

Fig. S4 CV curves of G-S-5 and G-S-10 electrodes in comparison with that of bare G-S electrode. Scan rate= 0.1 mV s^{-1}.

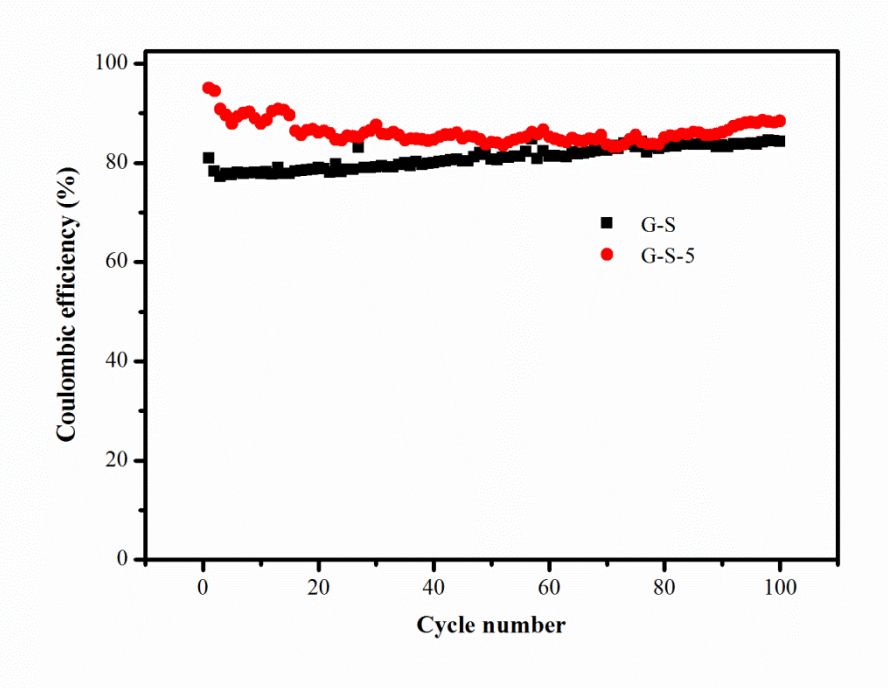

Fig. S5 Coulombic efficiencies of the G-S and G-S-5 composite electrodes during the process of charging/discrging at 0.5 C for 100 cycles.