Electronic Supplementary Information

Bowl-like Sulfur Particles Wrapped by Graphene Oxide as Cathode Material of Lithium-Sulfur Batteries

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1. Experimental section

1.1 Sulfur particles preparation

Sodium thiosulfate (0.004 mol) and a certain amount of PVP were dissolved in deionized water to form a 100 ml aqueous solution at room temperature. Then, 0.67 mL concentrated hydrochloric acid was added into the solution under magnetic stirring. After reacting for 2 hours, the precipitate was collected by suction filtration and washed with deionized water.

1.2 GO-wrapped bowl-like Sulfur composite synthesis

To prepare GO-BS composite, GO solution and as-prepared sulfur particles were mixed together in 1 M HCl (or NaCl) aqueous solution, and sonicated for 10 minutes. Then the suspensions were stirred for 1 hour. The products were collected, and washed with deionized water using centrifuge and suction filtration.

1.3 Characterization

The morphology and microstructure of obtained products were investigated by field emission scanning electron microscopy (FESEM, Hitachi S4800) operating at 80 KV and transmission electron microscopy (TEM, JEM-1230). The samples were prepared by dropping the products suspension on carbon-coated cooper grid (TEM) or silicon wafer (SEM) and drying in air. Thermogravimetric analysis (TGA) was recorded using a CHNS/O analyzer (PE 2400II, PerkinElmer, America) in the range of 35-400℃ at a heating rate of 5 ℃/min.

To prepare the working electrodes, GO-S particles were mixed with polyvinylidene fluoride (PVDF) binder and carbon black (8:1:1 by weight) in N-methyl-2-pyrrolidinone (NMP) to form a slurry. The slurry was coated onto aluminum foil using a glass rod and then dried at 60 ℃ for 12 hours to form the working electrodes. 2032-type coin cells were assembled in an argon-filled glovebox using lithium metal as counter electrode. Lithium bis(trifluoromethanesulfonyl)imide (1 M) in 1:1 v/v 1,2-dimethoxyethane (DME) and 1,3-dioxolane (DOL) containing 1 wt% $LiNO_3$ was used as the electrolyte. Galvanostatic cycling were carried out using a LAND Cell tester (Wuhan

Land Electronic Co., China) from 1.5 V- 3.0 V versus Li^+/Li^0.

2. Additional images

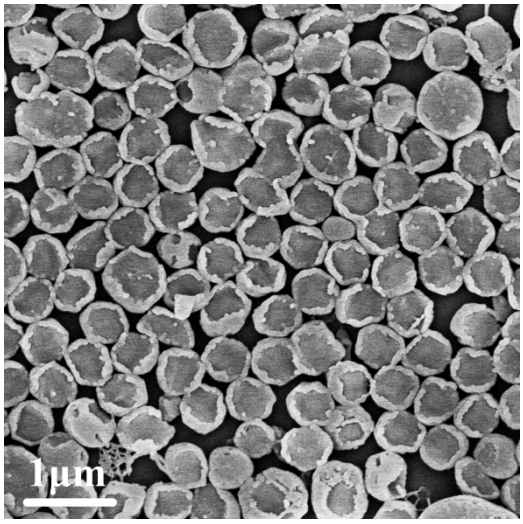

Fig. S1 Additional SEM image of prepared bowl-like sulfur particles.

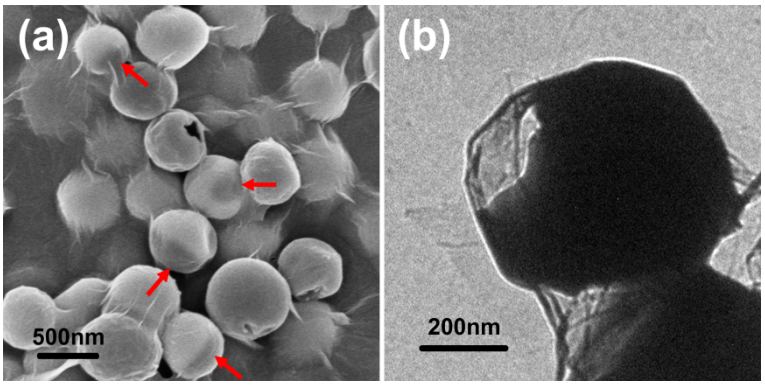

Fig. S2 Additional (a) SEM image and (b) TEM image of prepared GO-BS composite. Red arrows in the SEM image pointed out the visible void space inside the shell.

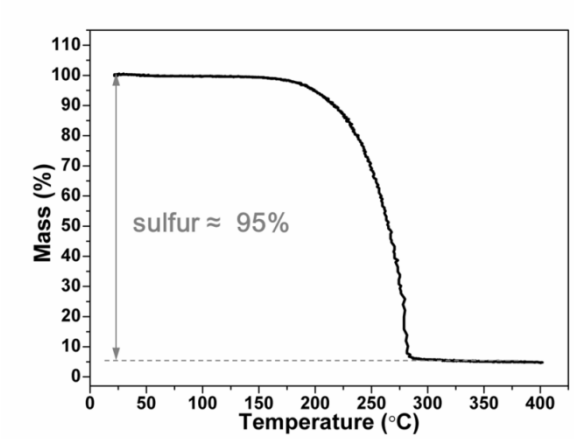

Fig. S3 Thermal gravimetric analysis (TGA) analysis curve of GO-wrapped sulfur composite recorded in the range of 35-400 ℃ at a heating rate of 5 ℃/min.

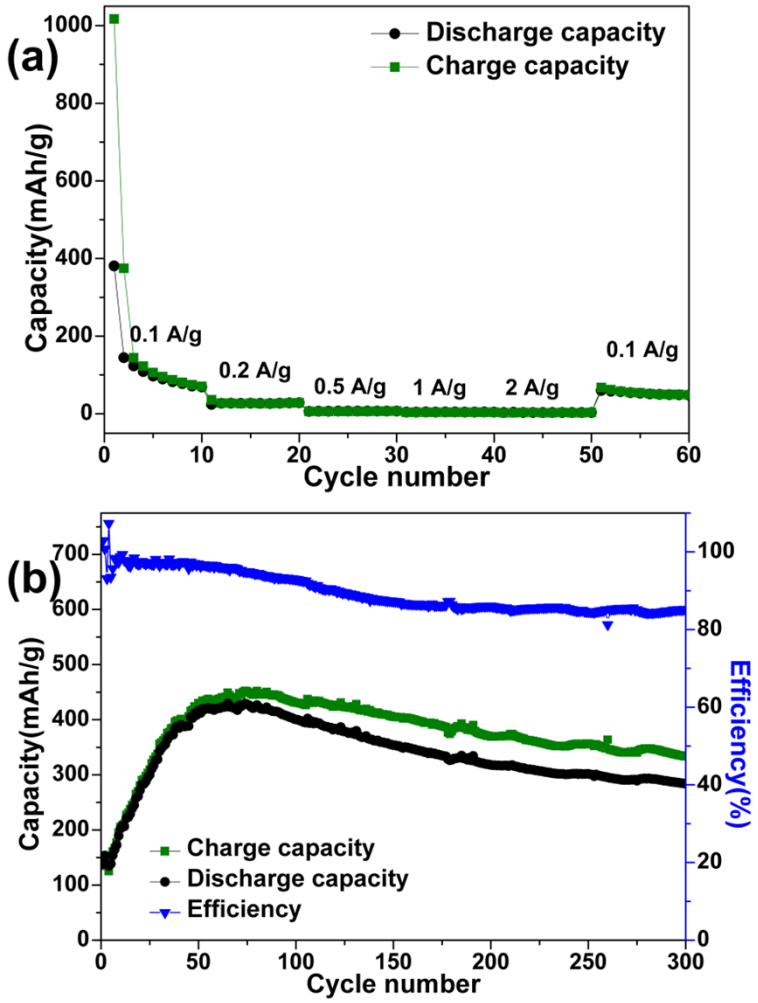

Fig. S4 (a) Rate properties of pure sulfur particles at different current rates. (b) Cycling performance of GO-wrapped solid sulfur (whose morphology was shown in fig. 1(a)) composite at 1 A/g. The initial discharge capacity was less than 200 mAh/g. After 300 cycles, the discharge capacity decayed faster and the efficiency was much lower than that of GO-BS cathode under exactly the same situation (Fig. 3(d)).