

Supplemental Information for:

**Sulfur@Graphene Oxide Core-shell Particles as a Rechargeable Lithium-Sulfur
Battery Cathode Material with High Cycling Stability and Capacity**

Min Xiao,¹ Miao Huang¹, Songshan Zeng^{1,2}, Dongmei Han¹, Shuanjin Wang,¹ Luyi Sun,²

Yuezhong Meng^{1}*

1. The Key Laboratory of Low-carbon Chemistry & Energy Conservation of Guangdong

Province/State Key Laboratory of Optoelectronic Materials and Technologies, Sun Yat-Sen

University, Guangzhou 510275, PR China

2. Department of Chemistry and Biochemistry & Materials Science and Engineering, and

Commercialization Program, Texas State University-San Marcos, San Marcos, TX, 78666,

USA.

Preparation of GO colloidal dispersion: GO was synthesized according to Hummer's method. A blend of graphite powder (5g) and sodium nitrate (2.5 g) was placed in cold (0 °C) concentrated H₂SO₄ (115 mL). KMnO₄ (15 g) was added gradually with stirring, keeping the temperature below 20°C. The mixture was then allowed to stir at 35 ± 3 °C for 30 min. Afterwards, 230 mL distilled water was slowly added, causing an increase in temperature to 98 °C. After stirring the solution at this temperature for 15 min, the reaction was terminated by adding 700 mL distilled water followed by 50 mL 30 % H₂O₂ solution. The mixture was filtered, washed successively with 5% HCl aqueous solution until sulfate could not be detected with BaCl₂. The collected precipitate was dispersed in 1000 mL water and ammonia solution was added to adjust the pH to 8-9. The mixture was stirred and bath sonicated to give a brown-colored colloidal dispersion, which was subjected to dialysis to completely remove residual salts and acids. The solid content of the GO colloidal dispersion was determined to be 4.5 mg/mL.

Synthesis of sulfur@GO composite: $\text{Na}_2\text{S}_2\text{O}_3$ (2.7g) was dissolved in 450mL water to which 5.4mL of 1% tetradecyltrimethylammonium chloride (TTAC) aqueous solution was added. After stirring for 5 minutes, 7.2mL of concentrated hydrochloric acid was added to the $\text{Na}_2\text{S}_2\text{O}_3$ solution. The solution was allowed to stir for 30 minutes to obtain a milky sulfur colloidal dispersion. Then 8 mL of GO colloidal dispersion was added drop by drop with stirring, brown precipitate was formed and the upper solution became clear. The precipitate was collected by centrifuge and washed successively with water and ethanol and then dried at 60°C under vacuum for 24 h.

Electrochemical Measurement: The sulfur@GO composite material powder was mixed with acetylene black and polyvinylidene fluoride (PVDF), with mass ratio of 70:20:10, in N-Methylpyrrolidone (NMP) solvent to produce electrode slurry. The well-mixed slurry was tape casted onto a sheet of aluminum foil and the film was dried in a convection oven at 80°C for 2 h, followed by pressing and punching out circular electrodes with a diameter of 14mm. The working electrode was further heated at 50°C under vacuum for 12h before cell assembly. The electrochemical measurements were carried out with 2025 coin cells assembled in an argon-filled glove box with lithium metal as anode. The electrolyte is lithium bis-trifluoromethanesulfonylimide (LiTFSI) in a 1 : 1 v/v mixture of 1,3-dioxolane(DOL) and 1,2-dimethoxyethane (DME). The cyclic voltammetry (CV) data were collected with a Solartron s1287 electrochemical interface at a scan rate of $1\text{mV}\cdot\text{s}^{-1}$ between 1.0 and 3.0 V. Charge–discharge performances of the cells were tested with a constant current density at a cut-off potential of 1.0–3.0 V under room temperature by LAND CT2001 instrument (Land Electronics Co., Ltd., Wuhan, China). All the specific capacities are calculated based on the mass of sulfur.

Supplementary figures:

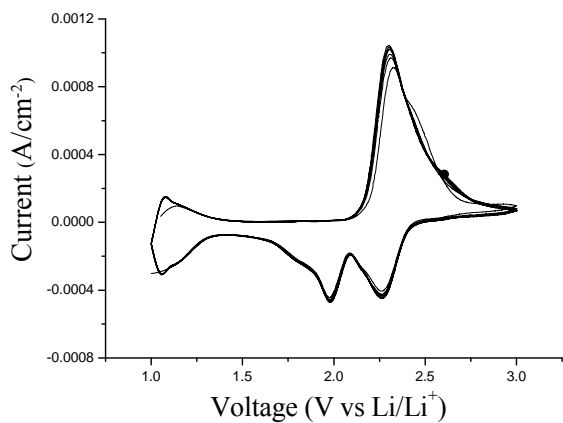


Figure S1. Cyclic voltammogram of the sulfur@GO composite cathode in a coin cell at a scan rate of $1\text{mV}\cdot\text{s}^{-1}$

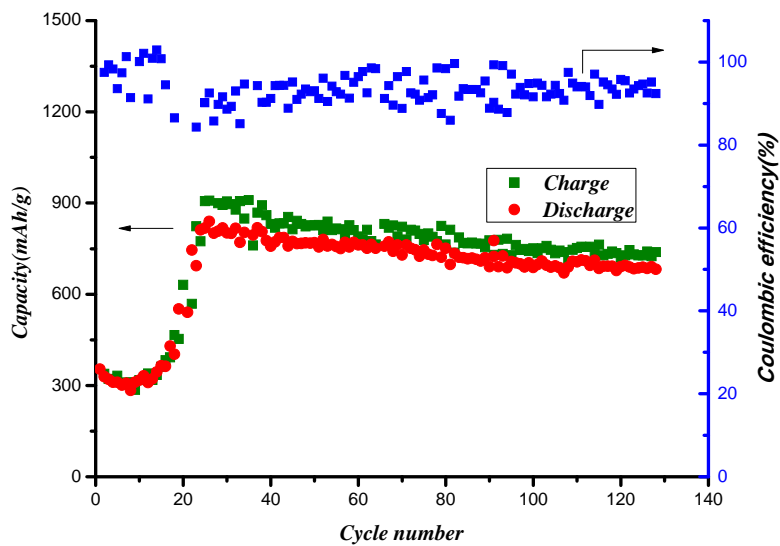


Figure S2. Electrochemical performance of another coin cell made with sulfur@GO composite materials as cathode at a current rate of $0.1\text{ C}(167\text{ mA}\cdot\text{g}^{-1})$.