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Electronic Supplementary Information

$C_{10}H_4O_2S_2$/graphene composite as cathode material for sodium-ion batteries

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Experimental Details

Preparation of Graphene

All the experimental chemicals were analytical grade and used without any further purification. Graphene was reduced from graphene oxide (GO) by heat-treatment. The GO was exfoliated from the graphite oxide according to the Hummers method with further modification. The details are as follows: firstly, in a three-necked flask in ice-water bath under stirring，30 mL of 98% H_2SO_4 was added slowly into a mixture of 0.4 g of natural graphite powder and 0.35 g of $NaNO_3$. After stirring for 1 h, 1.8 g of $KMnO_4$ (purity 99%) was added gradually under slow stirring for about 3 h. The as-formed mixture was reacted for seven days at room temperature. Afterwards, 40 mL of 5wt% H_2SO_4 aqueous solution was added dropwise and stirred for 1 h. After that, 1.2 mL of 30wt% H_2O_2 aqueous solution was added, and the solution was stirred for another 1 h. Then, this solution was washed thoroughly several times with a mixed aqueous solution of 3wt% H_2SO_4/0.5wt% H_2O_2 and deionized (DI) water several times, respectively. After centrifuging, a brown-black graphite oxide dispersion was obtained. The graphite oxide dispersion was sonicated for 5 h at 50 ^oC to form a stable GO dispersion. Finally, the GO was put into a quartz boat in the center of a tube furnace. After introducing flowing 25% H_2-75% Ar combination gas for about 10 min

and setting the temperature ramp rate for the furnace at 50°C min^{-1}, the furnace was heated up to 900ºC for 2 h. Graphene was obtained after furnace cooling below 50ºC.

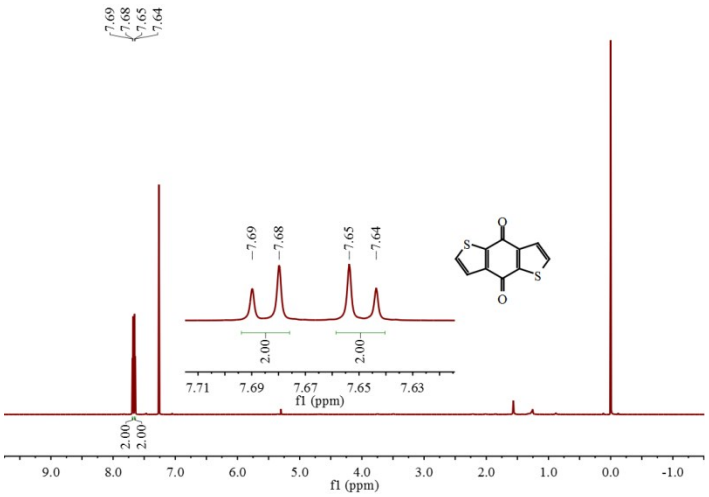

Fig. S1 ^{1}H NMR spectrum of BDT.

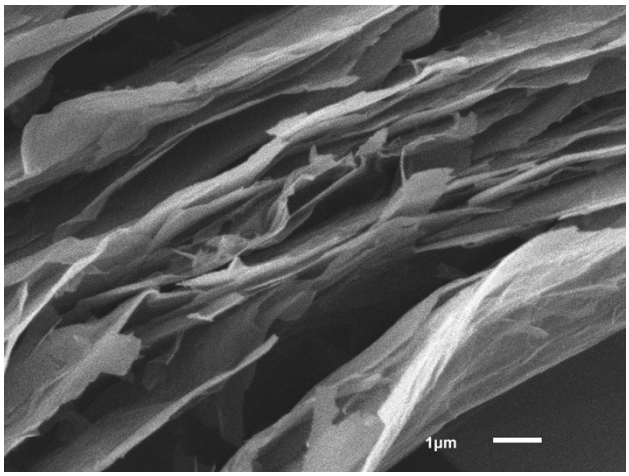

Fig. S2 SEM images of the as-prepared graphene (G).

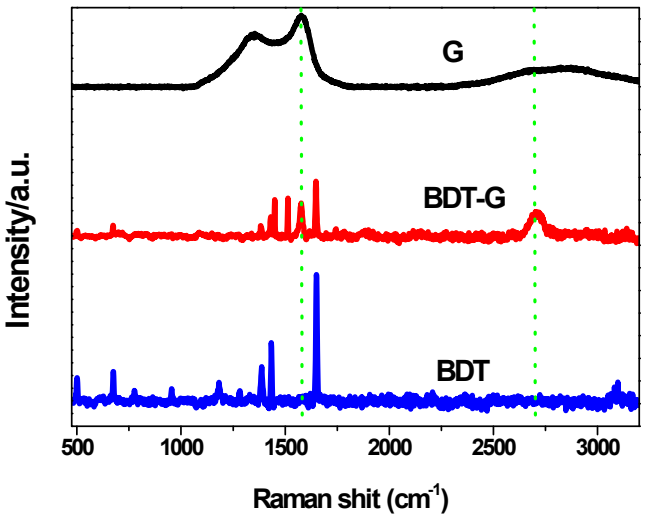

Fig.S3 Raman spectra of G, BDT-G and BDT.

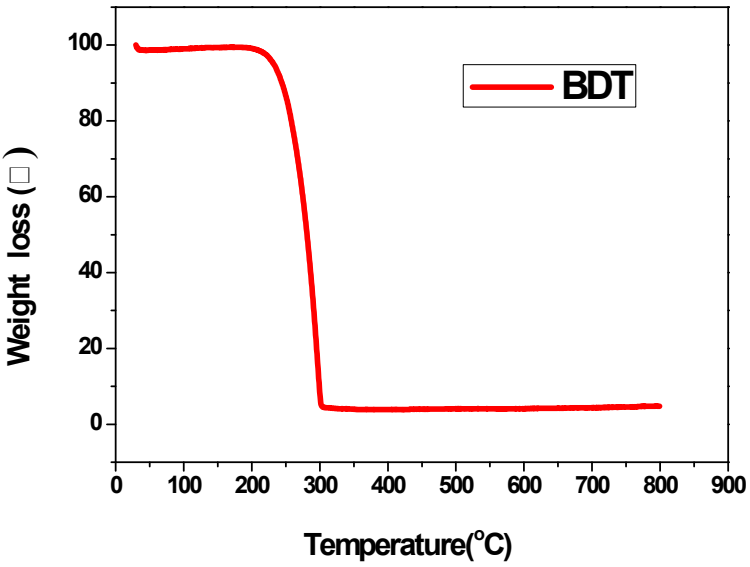

Fig. S4 TGA curve of BDT.

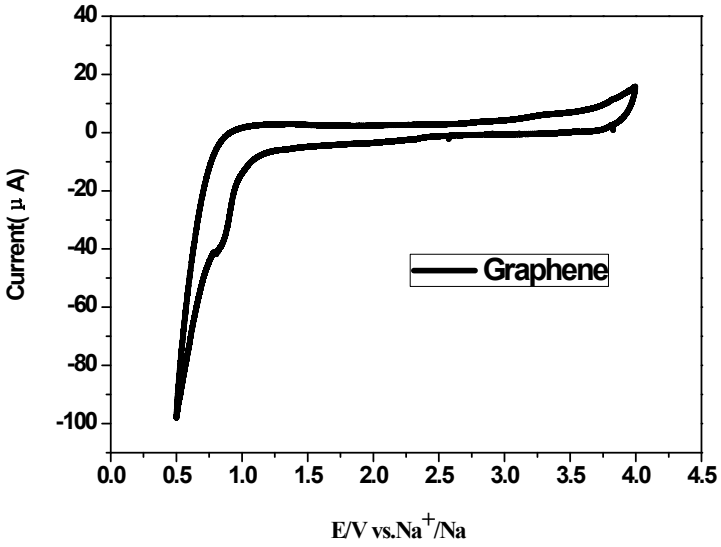

Fig. S5 The first cyclic voltammograms for graphene (G), scan rate: 0.1 mV/s

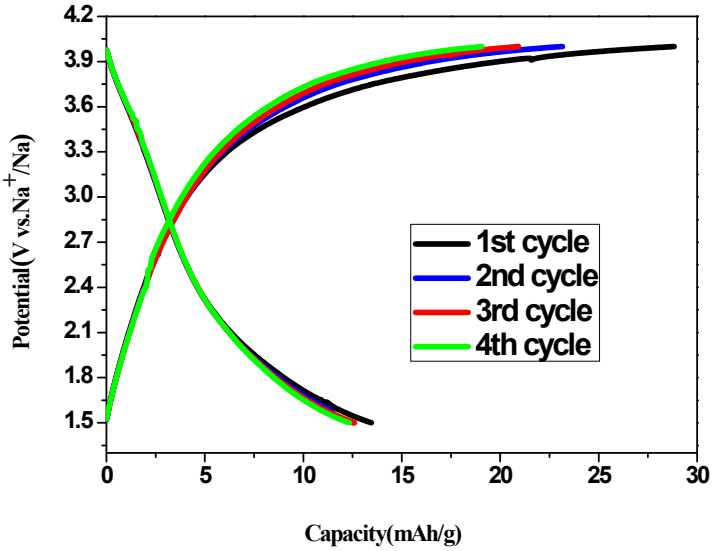

Fig. S6 The initial four charge/discharge curves of graphene electrode (G) at the current density of 0.1C

Table S1. Electrochemical impedance parameters by fitted for BDT and BDT-G electrodes after 5,10,70 cycles.

	BDT	BDT-G (after 5 cycle)	BDT-G (after 10cycle)	BDT-G (after 70 cycle)
R_s (Ω)	1.45	3.15	9.313	5.764
R_{ct} (Ω)	1192	374.3	659.5	1193
$W_{O1\text{-}R}$(Ω)	315.3	404.7	52.3	151.3

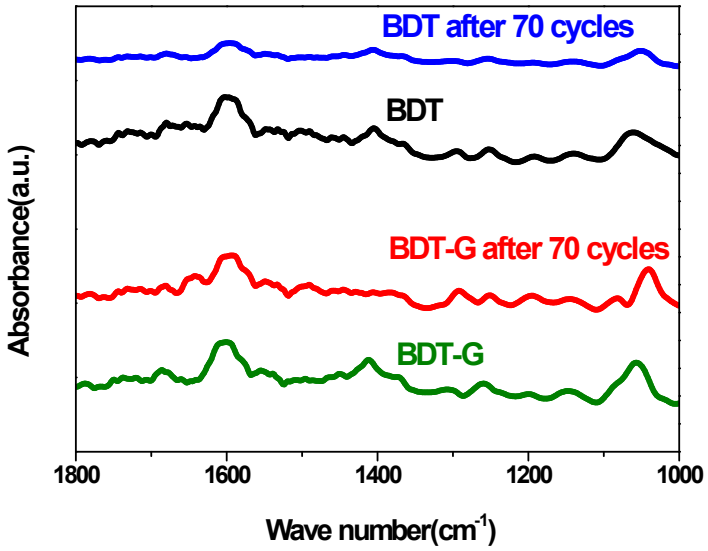

Fig. S7 The FT-IR spectras of BDT and BDT-G electrodes before and after cycles

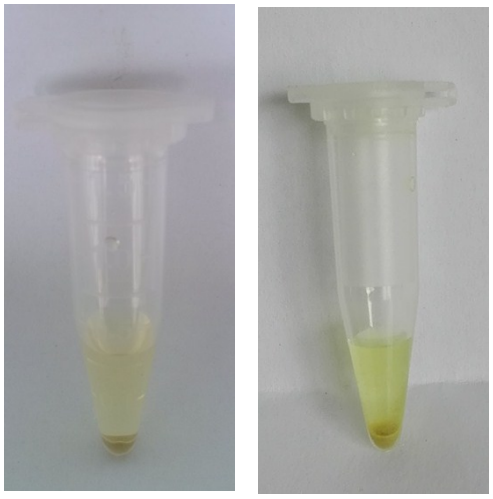

Fig. S8 The photos of solution experiment of BDT in electrolyte

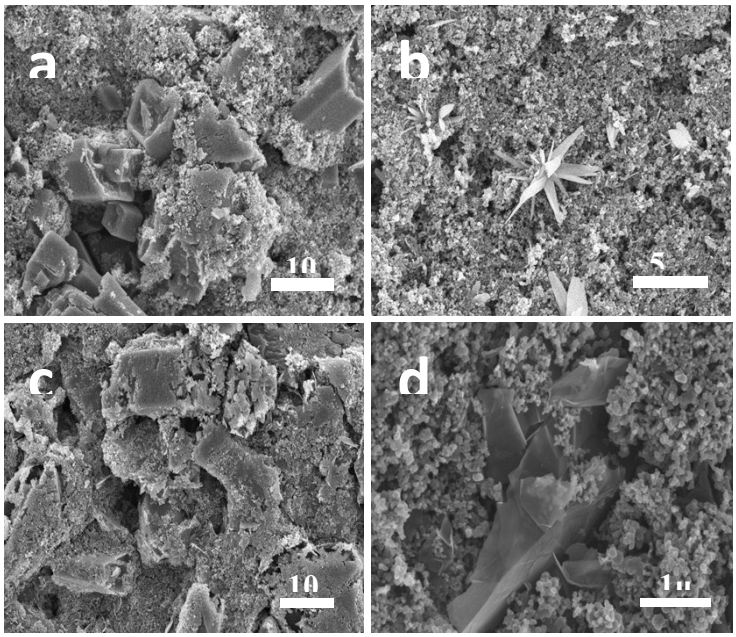

Fig. S9 The SEM images of BDT before and after cycling (a, before; b, after), and the SEM images of BDT-G before and after cycling (c, before; d, after).