S is the main active material of cathode material in lithium-sulfur battery, so in the process of preparing cathode material, we all want to increase the content of sulfur, that is, less Fe_2O_3/rGO/CNT as much as possible. The effects of 40 wt%, 30 wt% and 20 wt% Fe_2O_3/rGO/CNT on electrochemical performance were tested, as shown in Fig. S1. With the increase of the proportion of Fe_2O_3/rGO/CNT, that is, the increase of S content, the specific capacity and cycle performance of the electrode materials decreased. This is mainly due to the fact that S is a non-conductor and the increase of S content leads to the decrease of conductivity, polarization and electrochemical properties of cathode materials.

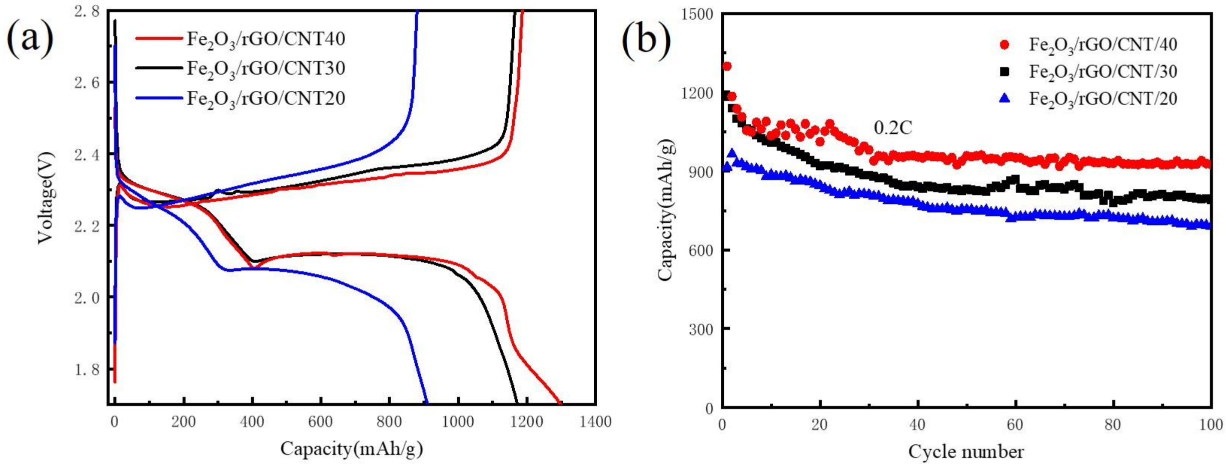

Fig. S1 Effect of Fe_2O_3/rGO/CNT ratio on the performance of the Li-S battery

In order to eliminate the influence of Fe_2O_3/rGO/CNT on the capacity of the system, the capacity of Fe_2O_3/rGO/CNT was tested separately, shown in Fig. S2. At 0.2C rate, the initial discharge capacity of Fe_2O_3/rGO/CNT is only ~ 190 mAh/g, and the initial charge capacity is ~ 64 mAh/g. After 100 cycles, the charge capacity is only ~ 22 mAh/g, which is negligible for the capacity of cathode materials in this paper. The low capacity of Fe_2O_3/rGO/CNT is due to the voltage range of 1.7-2.8 V tested for lithium-sulfur batteries. Although the theoretical capacity of Fe_2O_3 is ~1000mAh/g, but it is tested at the voltage range of 0-2V as the anode material of lithium-ion battery. At the same time, the electrolyte systems of lithium-sulfur battery and lithium-ion battery are also different. According to the synthesis process, the mass ratios of Fe_2O_3, rGO, CNT and S in Fe_2O_3/rGO/CNT are 6%, 17%, 17% and 60%, respectively.

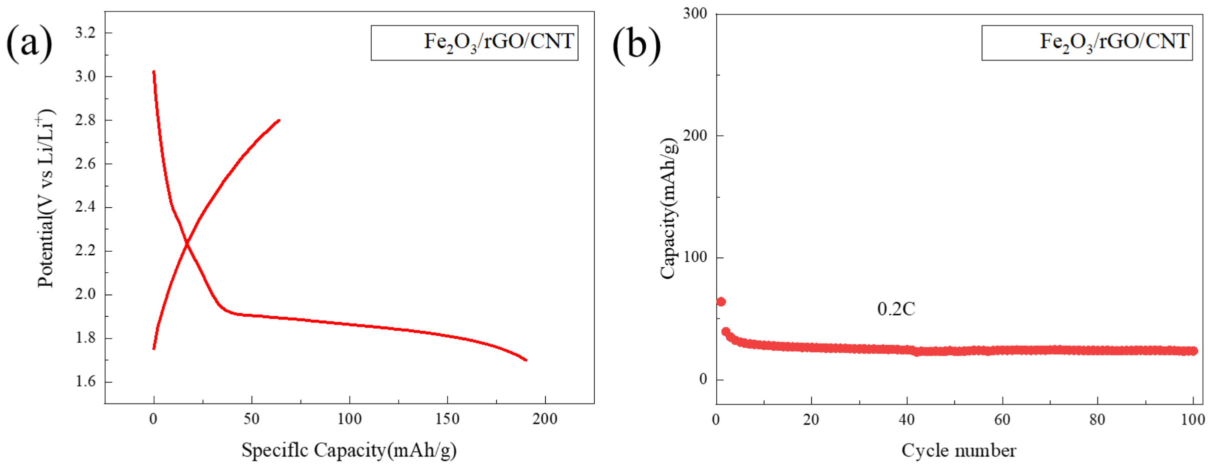

Fig. S2 The initial charge-discharge curves (a) and cycle performance (b) of Fe_2O_3/rGO/CNT