Supporting Information

In-situ Formed Hollow Cobalt Sulfide Wrapped by Reduced Graphene Oxide as an Anode for High-Performance Lithium-ion Batteries

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Table S1. Co, S content and Co/S molar ratio of $Co_{1-x}S$ and in-situ $Co_{1-x}S$/rGO determined by inductively coupled plasma (ICP).

Sample	Co (wt%)	S (wt%)	Co:S (molar ratio)
$Co_{1-x}S$	26.9	15.1	0.97
In-situ $Co_{1-x}S$/rGO	22.8	12.0	1.03

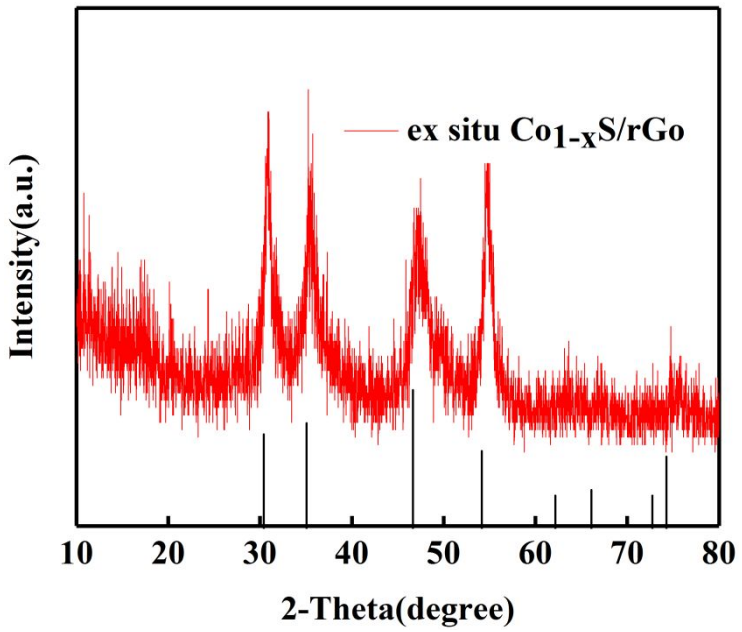

Figure S1. X-ray diffraction patterns of ex-situ $Co_{1-x}S$/rGO.

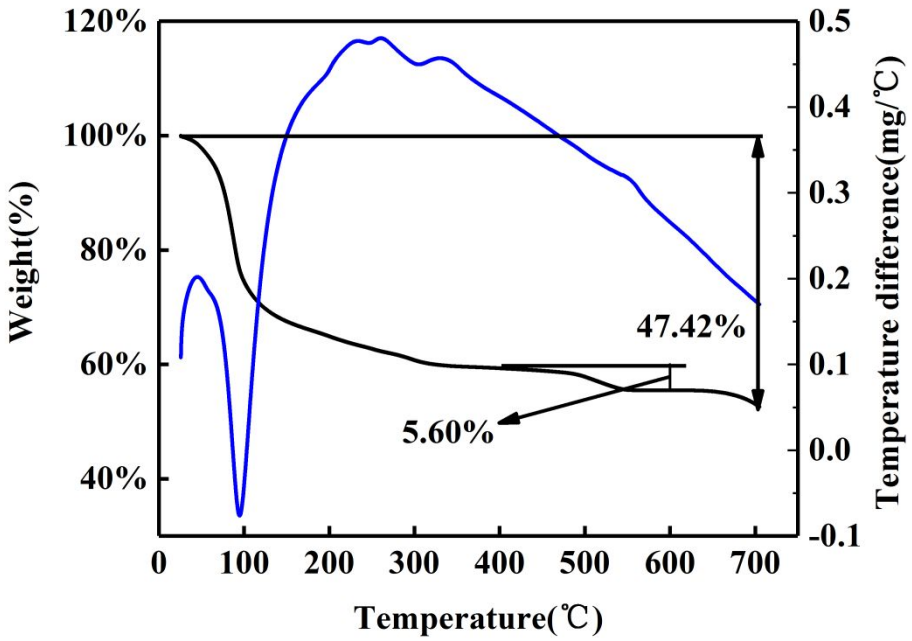

Figure S2. TGA curve for the in-situ $Co_{1-x}S$/rGO between room temperature and 700˚C measured with a heating rate of 5 ˚C·min^{-1} under air atmosphere.

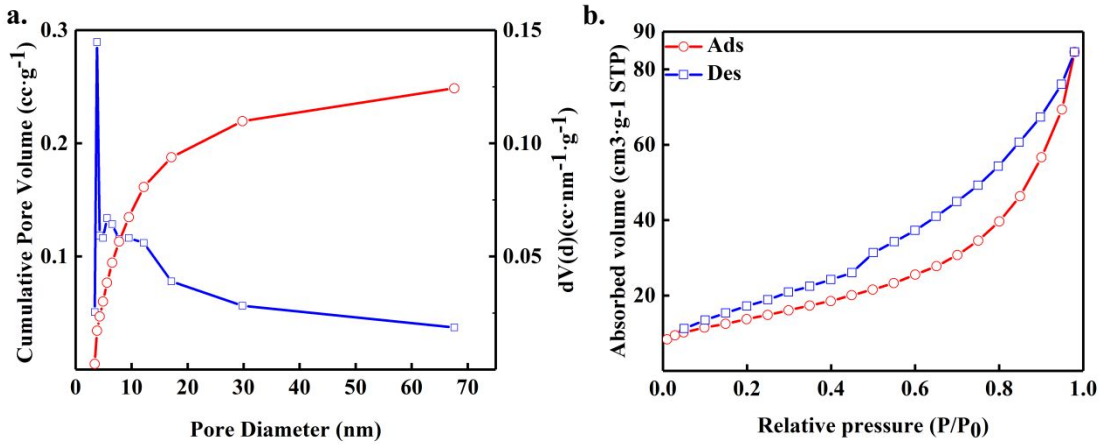

Figure S3. N_2 adsorption-desorption isotherm (a) and pore size distribution curve (b) of the in-situ $Co_{1-x}S$/rGO.

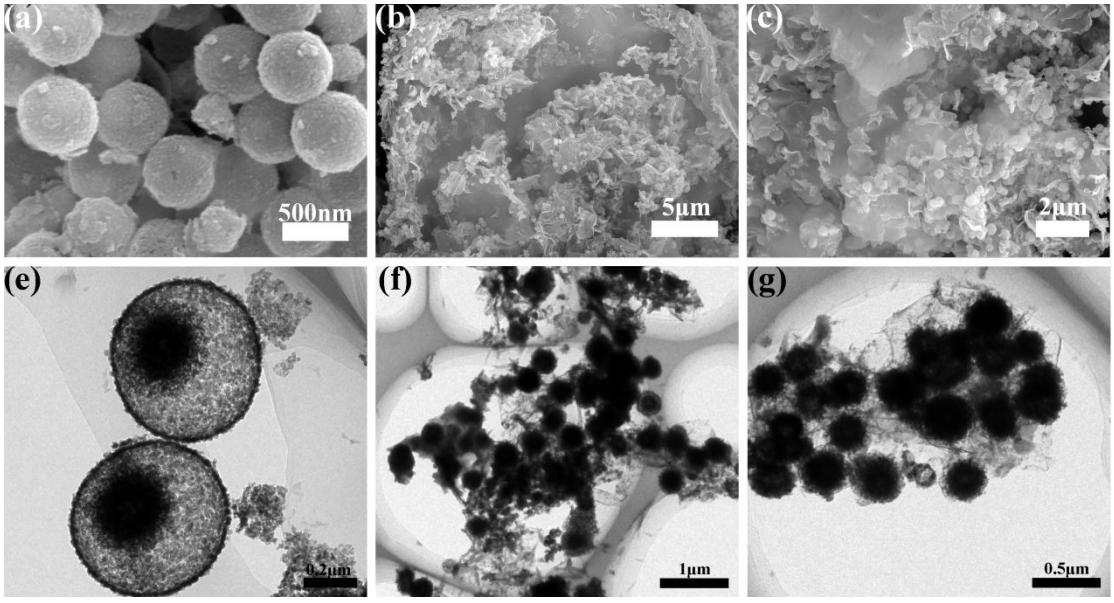

Figure S4. (a-c) SEM images of $Co_{1-x}S$ and in-situ $Co_{1-x}S$/rGO. (e-g) TEM images of $Co_{1-x}S$ and in-situ $Co_{1-x}S$/rGO.

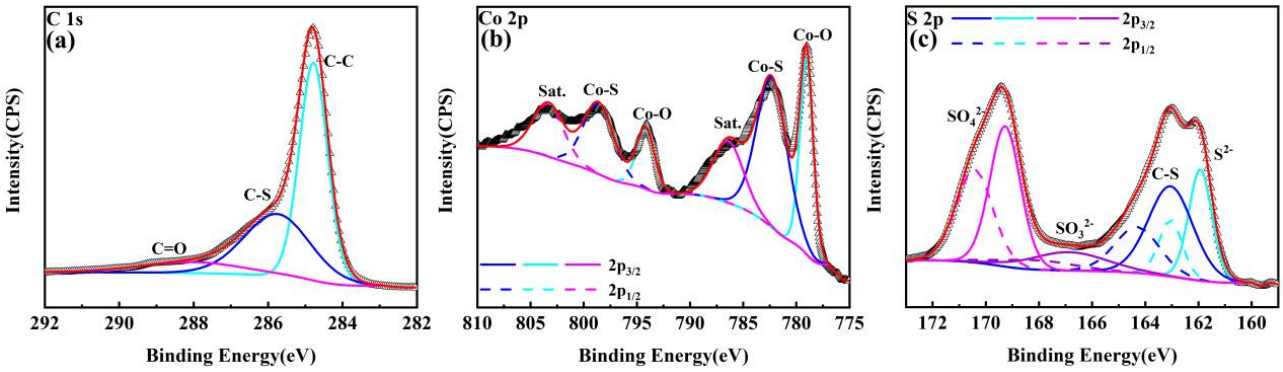

Figure S5. XPS spectra of $Co_{1-x}S$ hollow spheres. (a) C 1s, (b) Co 2p, and (c) S 2p spectra for $Co_{1-x}S$.

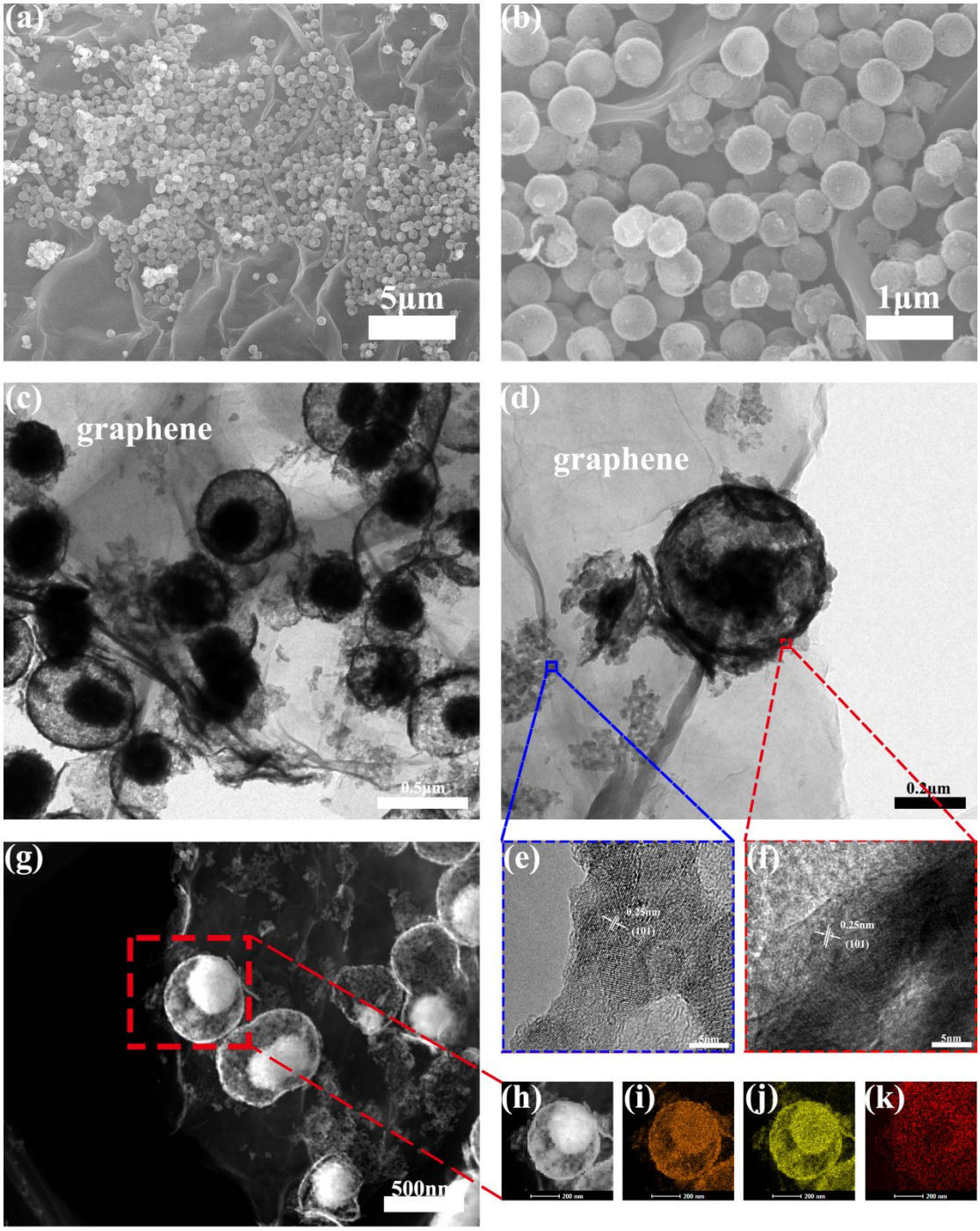

Figure S6. SEM images of ex-situ $Co_{1-x}S$/rGO and TEM images, Element mapping and high magnification TEM images of ex-situ $Co_{1-x}S$/rGO.

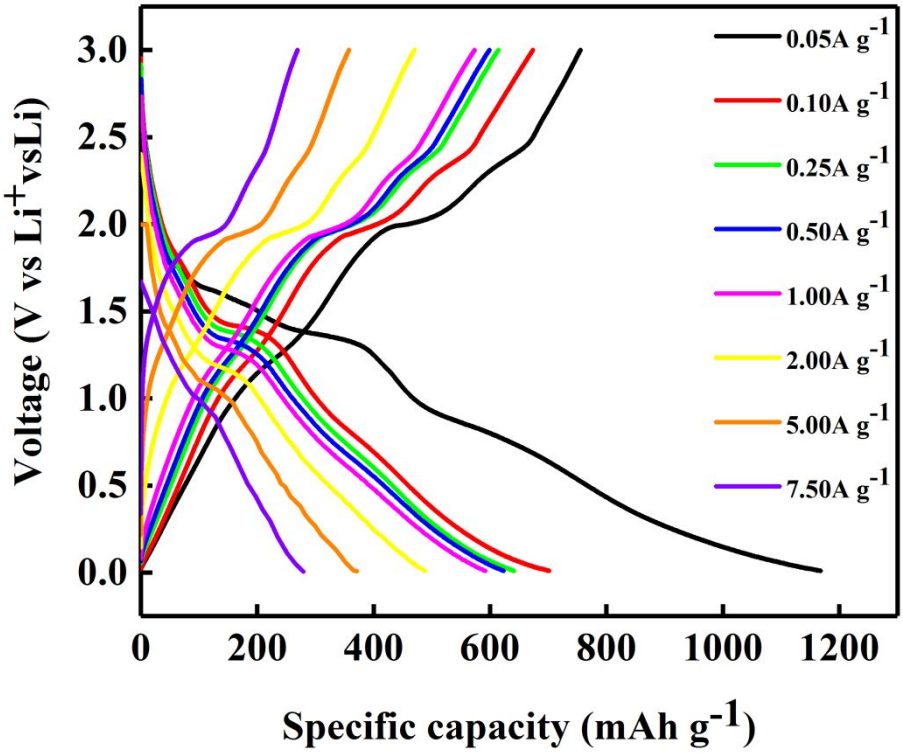

Figure S7. Rate performance of $Co_{1-x}S$/rGO electrode at various current densities of 0.05, 0.1, 0.25, 0.5, 1.0, 2.0 and 5.0 A·g^{-1}.

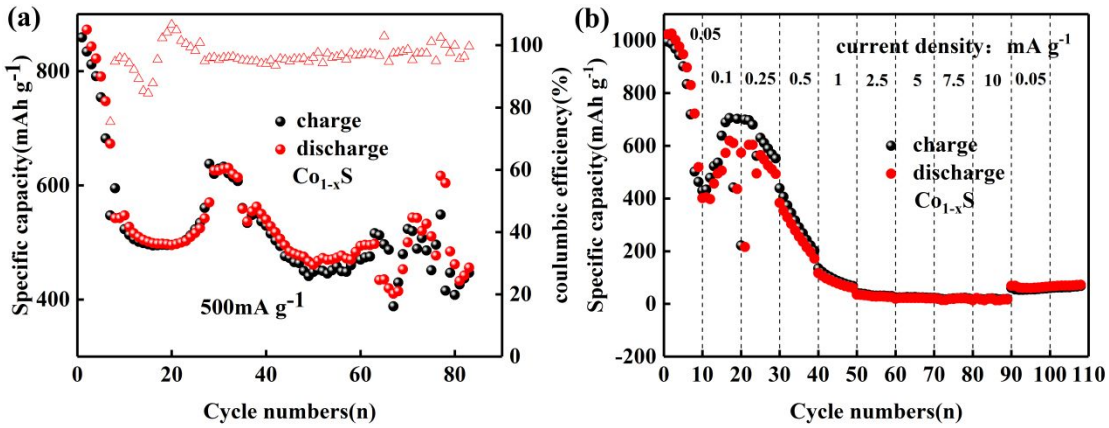

Figure S8. Cycling (a) and rate (b) performance of $Co_{1-x}S$ composite in the voltage range of 0.01-3V.

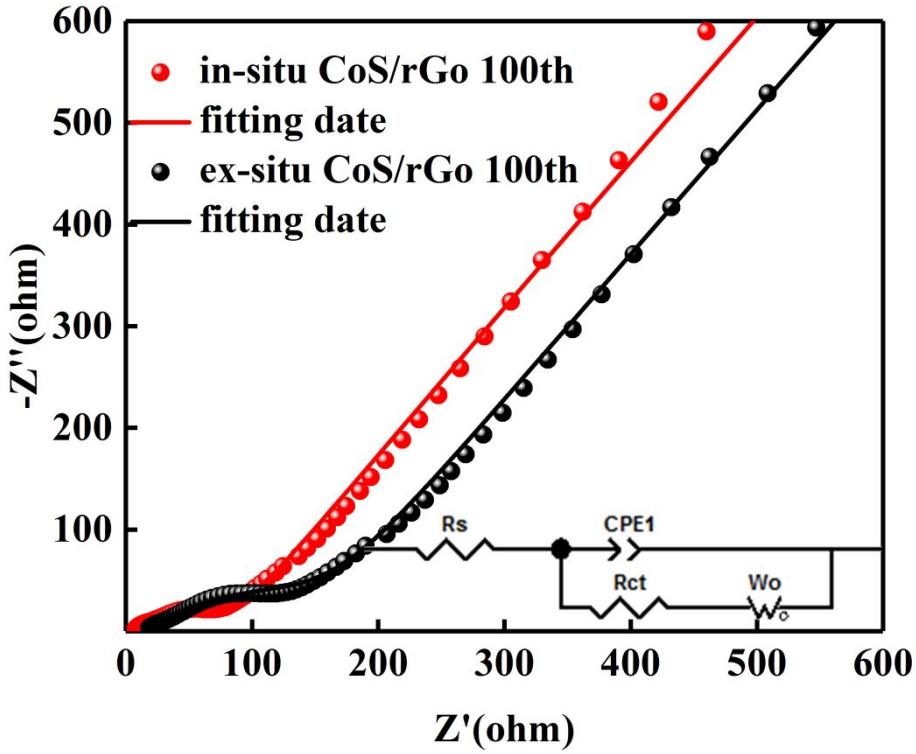

Figure S9. Electrochemical impedance spectra of in-situ $Co_{1-x}S$/rGO and ex-situ $Co_{1-x}S$/rGO at a cyclic rate of 500 mA·g^{-1} after 100th cycle.

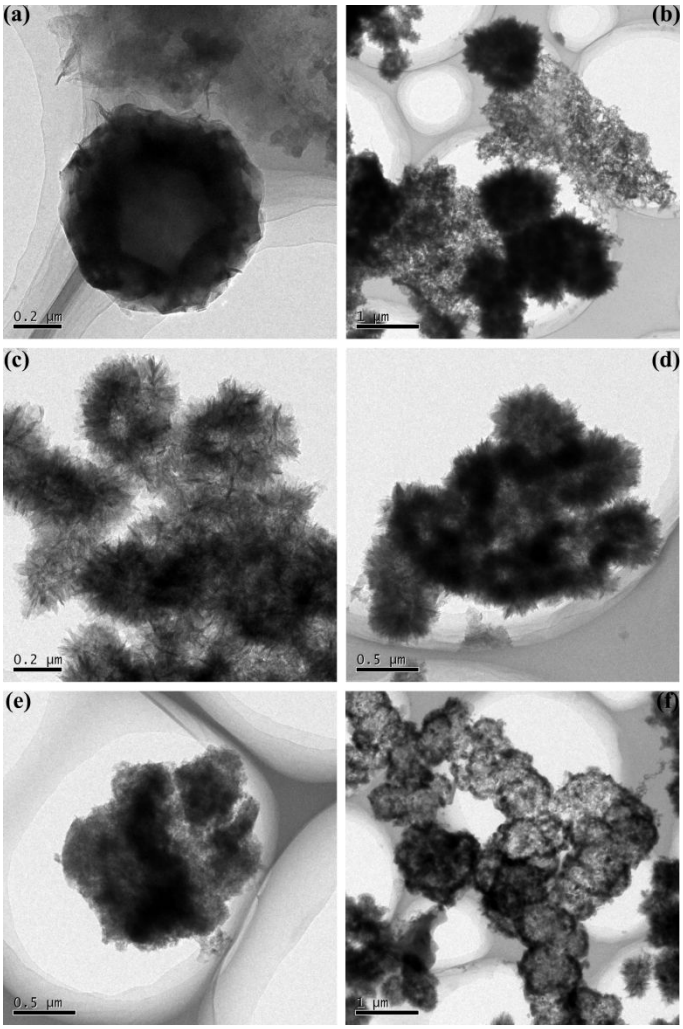

Figure S10. TEM images of in-situ $Co_{1-x}S$/rGO (a, b), ex-situ $Co_{1-x}S$/rGO (c, d), $Co_{1-x}S$ (e, f) after 90 cycles.