**Supporting Information**

# Efficient Entrapment and Catalytic Conversion of Lithium Polysulfides on Hollow Metal Oxides Submicro-spheres as Lithium-Sulfur Battery Cathodes

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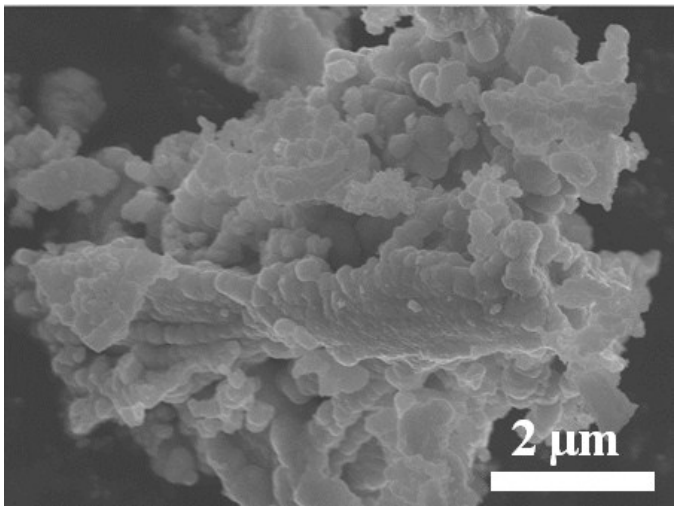


**Fig. S1** SEM image of the solid $Co_3O_4$ control sample.

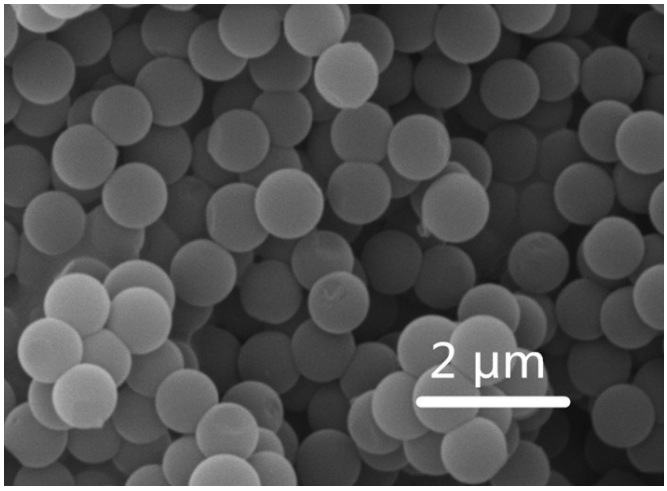


**Fig. S2** SEM image of the RF sphere template.

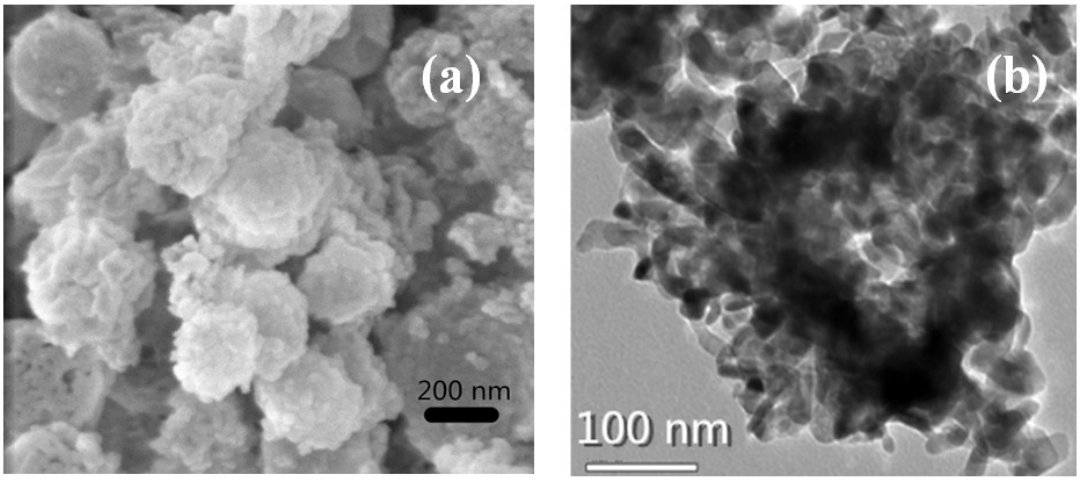


**Fig. S3** (a) SEM and (b) TEM images of the $Mn_2O_3$ spheres.

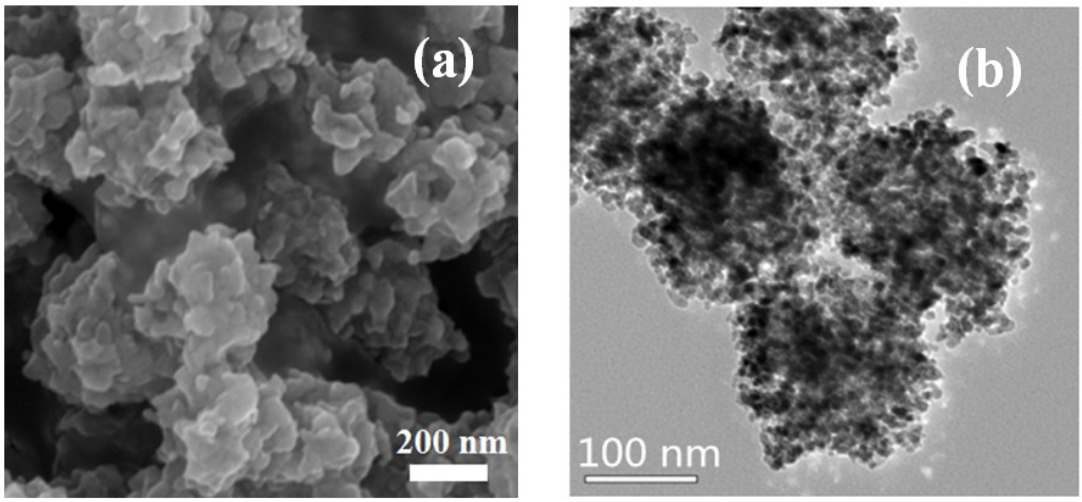


**Fig. S4** (a) SEM and (b) TEM images of the NiO spheres.

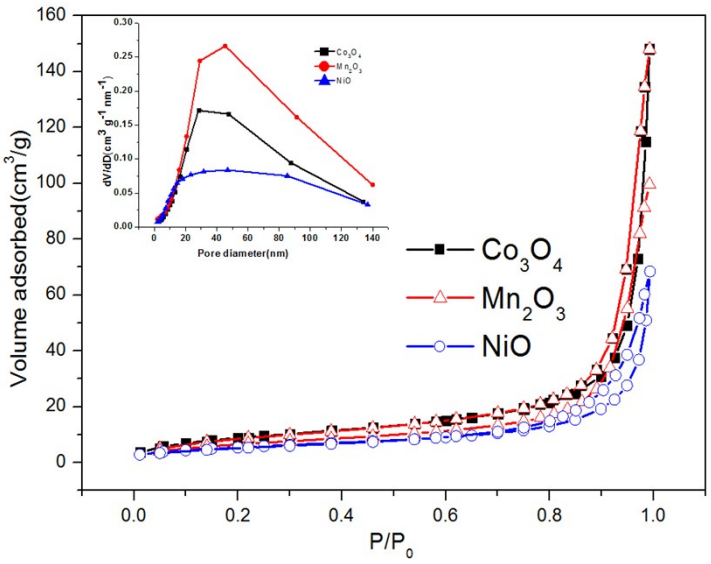


**Fig. S5** $N_2$ adsorption/desorption curves and pore size distribution patterns of the $Co_3O_4$, $Mn_2O_3$, and NiO samples.

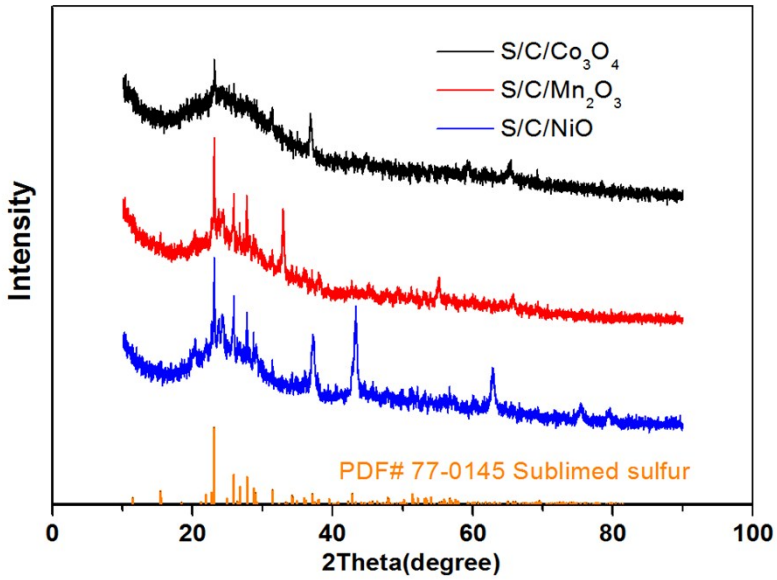


**Fig. S6** XRD patterns of the S/C/$Co_3O_4$, S/C/$Mn_2O_3$, and S/C/NiO composites.

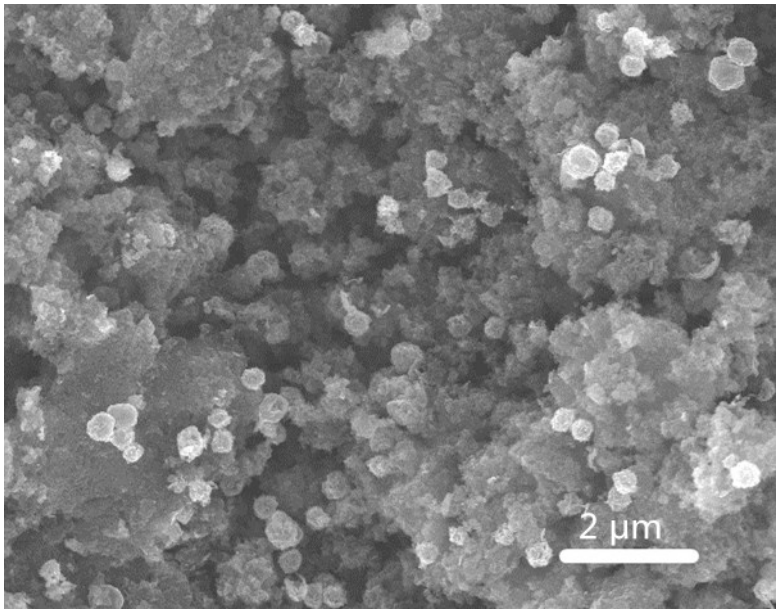


**Fig. S7** SEM image of the S/C/$Co_3O_4$ material.

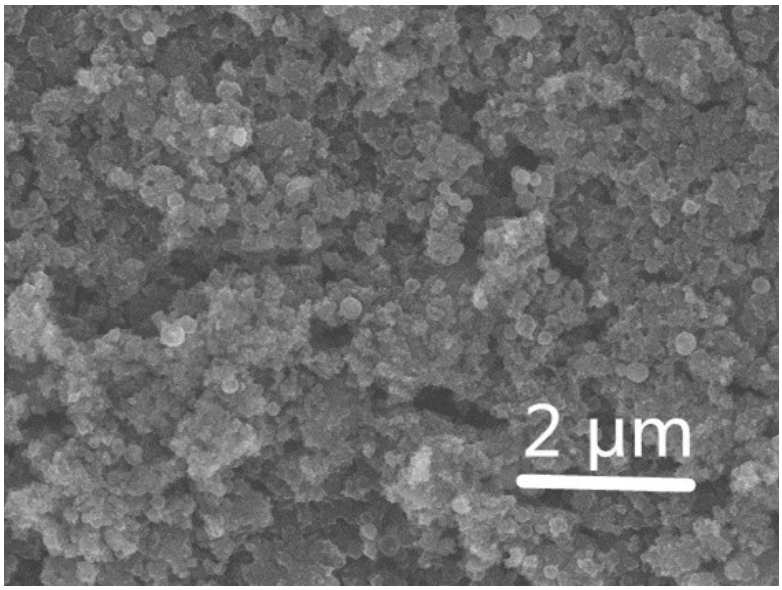


**Fig. S8** SEM image of the S/C/$Mn_2O_3$ material.

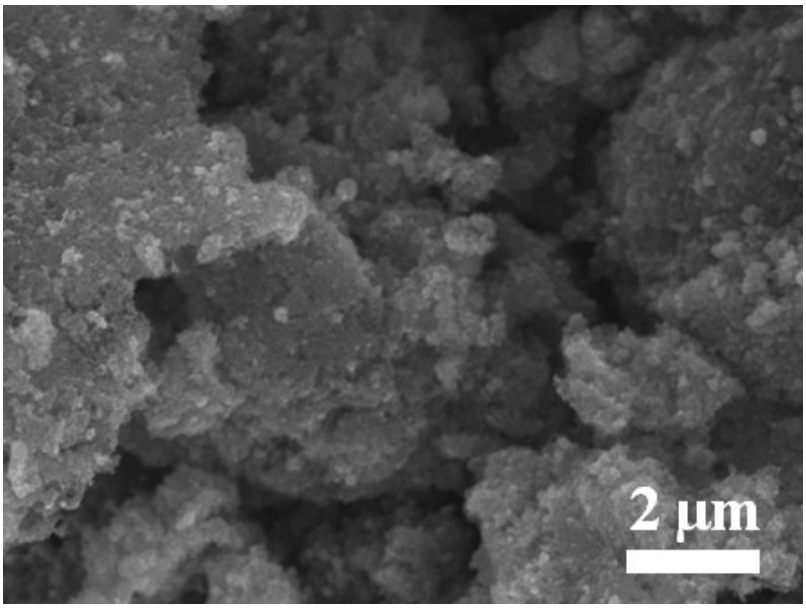


**Fig. S9** SEM image of the S/C/NiO material.

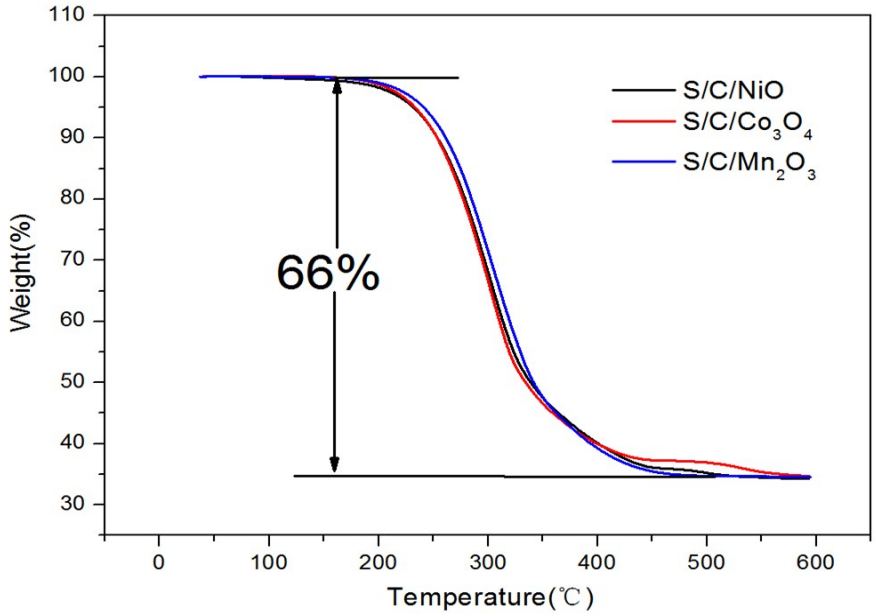


**Fig. S10** TGA results of the S/C/$Co_3O_4$, S/C/$Mn_2O_3$, and S/C/NiO composites.

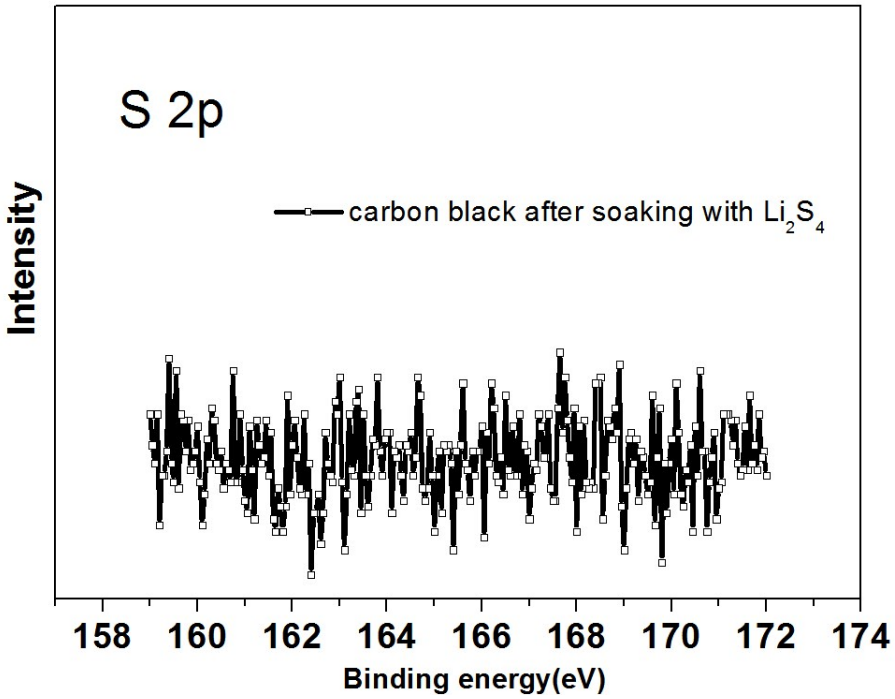


**Fig. S11** XPS spectrum (S 2p) of bare carbon black after immersion in a $Li_2S_4$ solution.

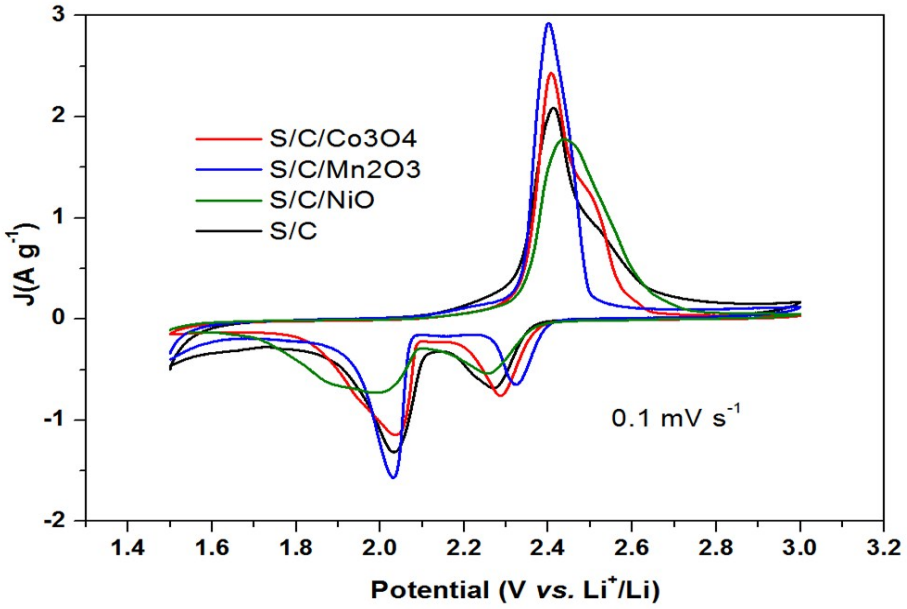


**Fig. S12** CV curves of the S/C/$Co_3O_4$, S/C/$Mn_2O_3$, S/C/NiO, and S/C electrodes with a scan rate of 0.1 mV $s^{-1}$.

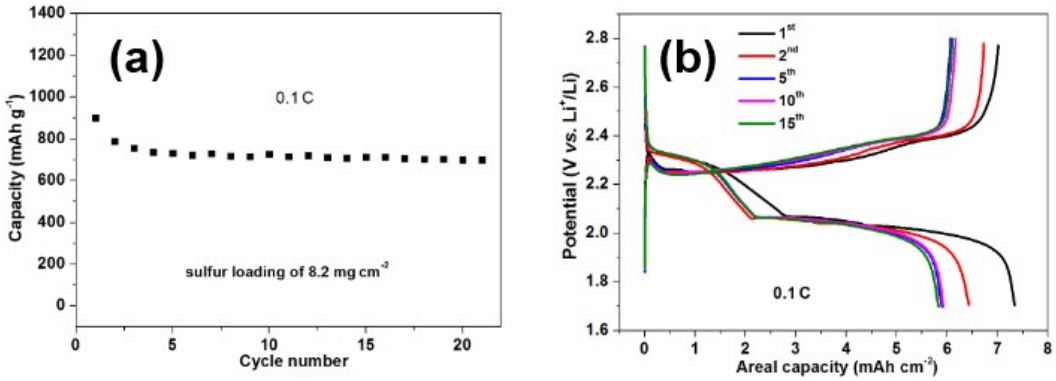


**Fig. S13** (a) Cycling performance of S/C/$Co_3O_4$ with a sulfur loading of 8.2 mg $cm^{-2}$ at 0.1 C; (b) the corresponding areal capacity *vs.* potential curve of the high sulfur loading S/C/$Co_3O_4$. The S/C/$Co_3O_4$ electrode was prepared by casting S/C/$Co_3O_4$ and sodium alginate slurry onto a nickel foam disk. The other preparation procedure is the same as the low sulfur loading electrode described in the main text.

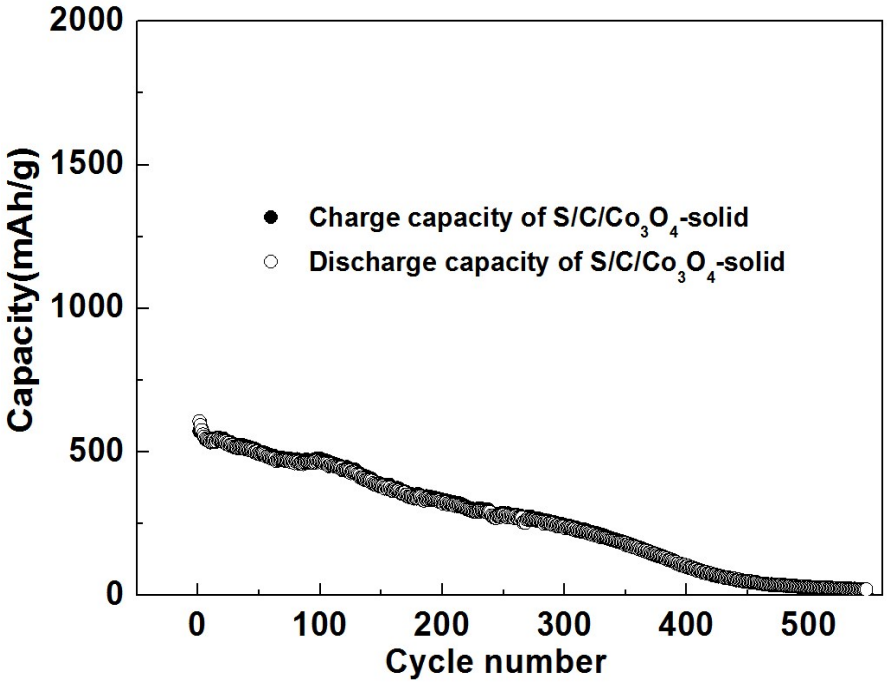


**Fig. S14** Cycling performance of the S/C/$Co_3O_4$-solid cathode at 0.5 C.

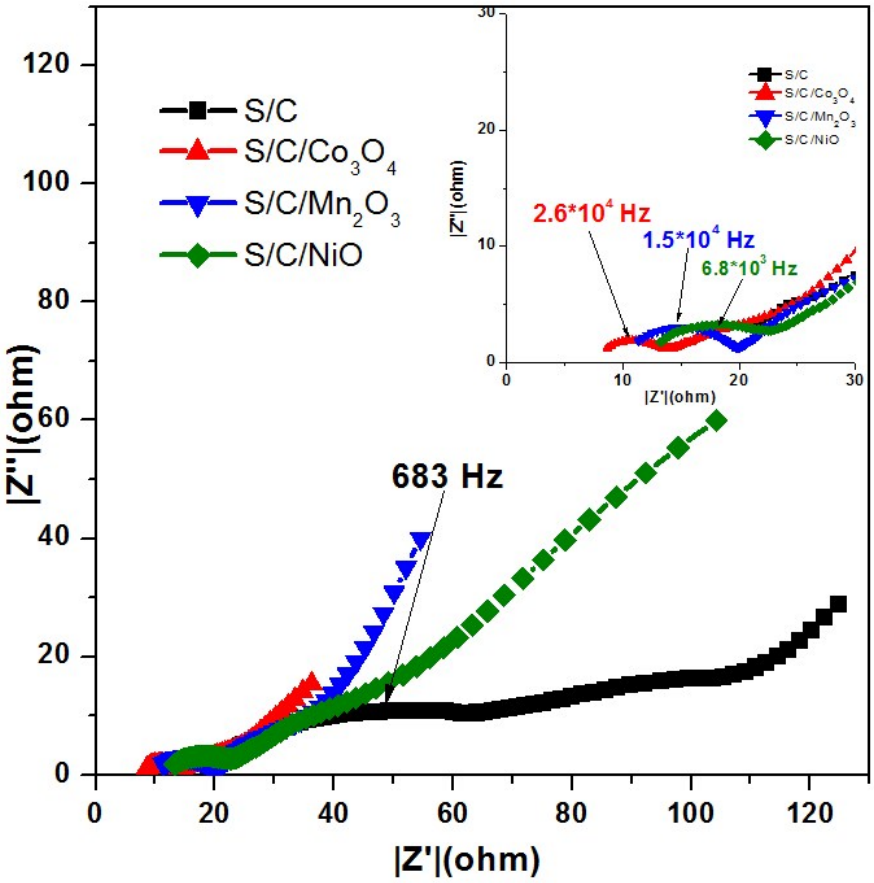


**Fig. S15** EIS plots of the S/C/$Co_3O_4$, S/C/$Mn_2O_3$, S/C/NiO, and S/C electrodes from 100000 Hz to 0.1 Hz. (The cells are on fully charged state after 2 cycles of discharge/charge at 0.1 C)

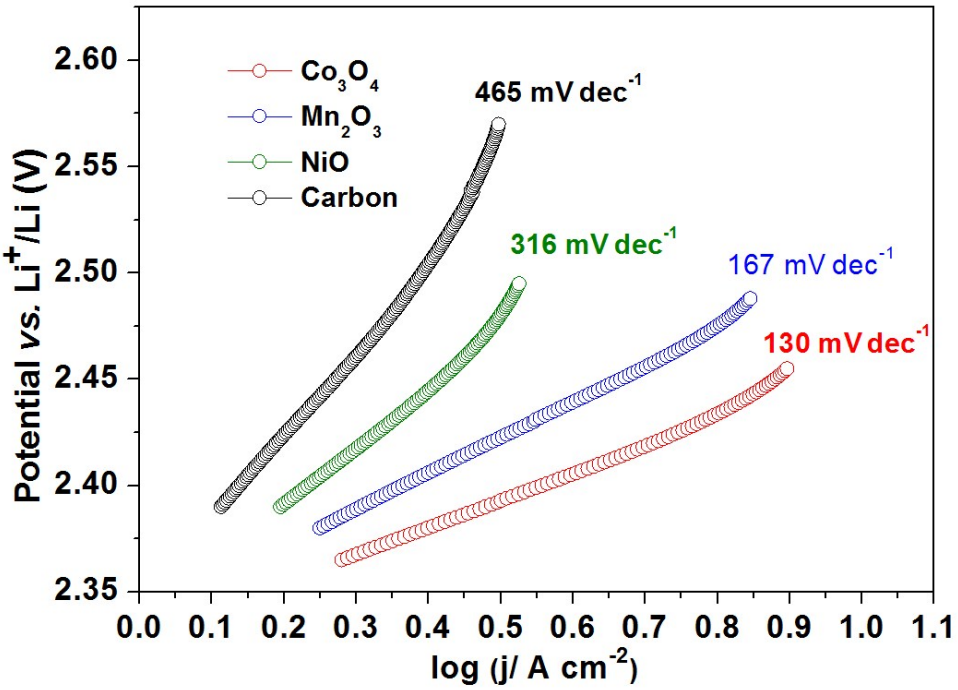


**Fig. S16** Tafel plots for $Co_3O_4$, $Mn_2O_3$, NiO and bare carbon in 0.1 M $Li_2S_8$.