Supplementary information

**Self-adaptive mesoporous CoS@alveolus-like carbon yolk-shell microsphere for alkali cations storage**

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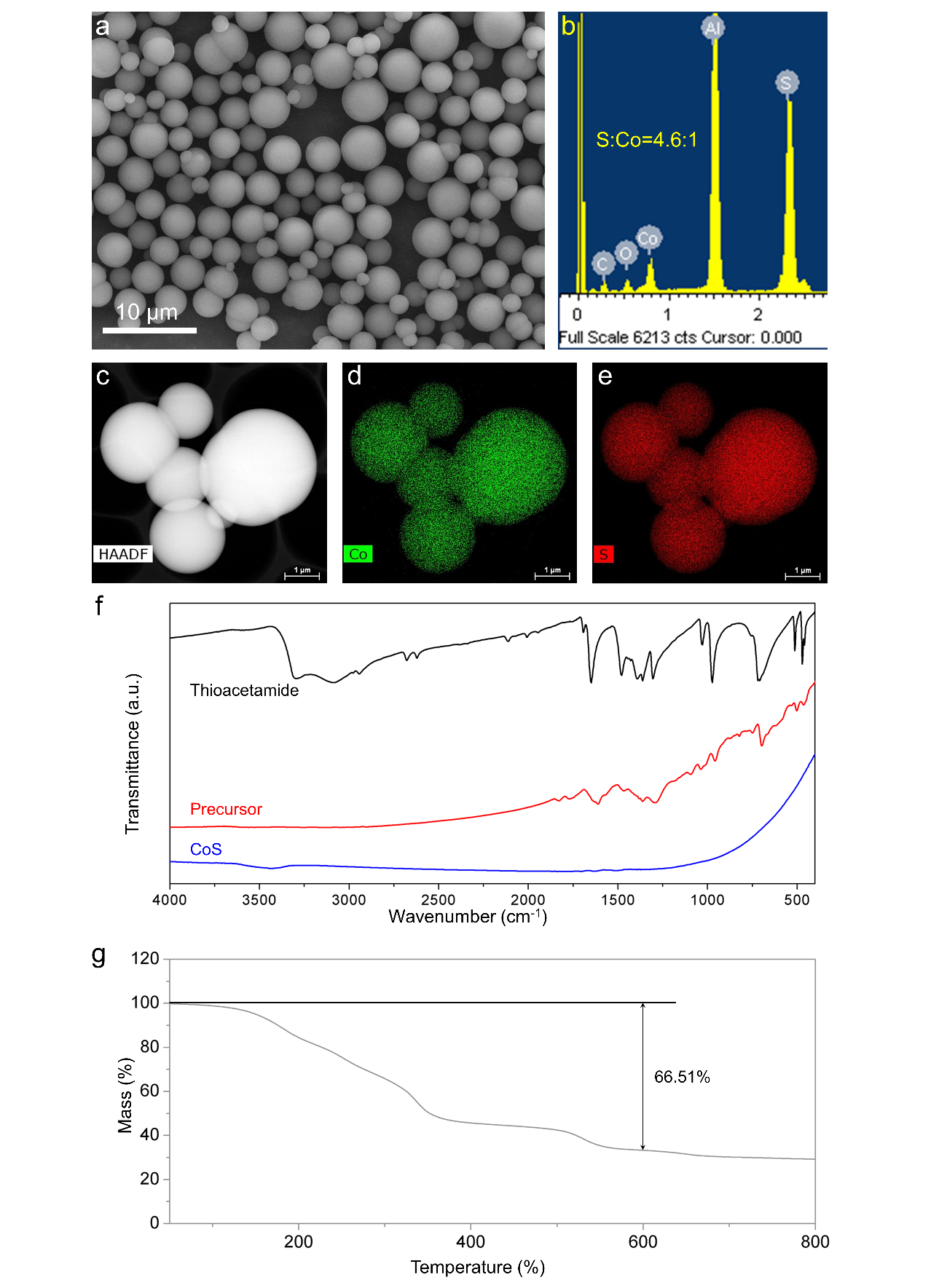
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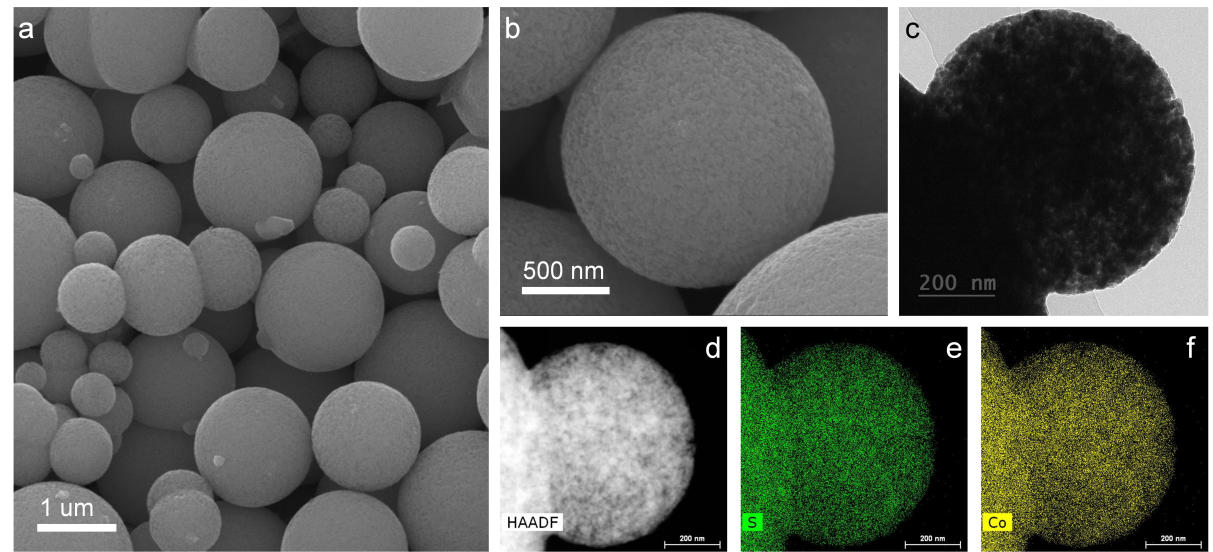
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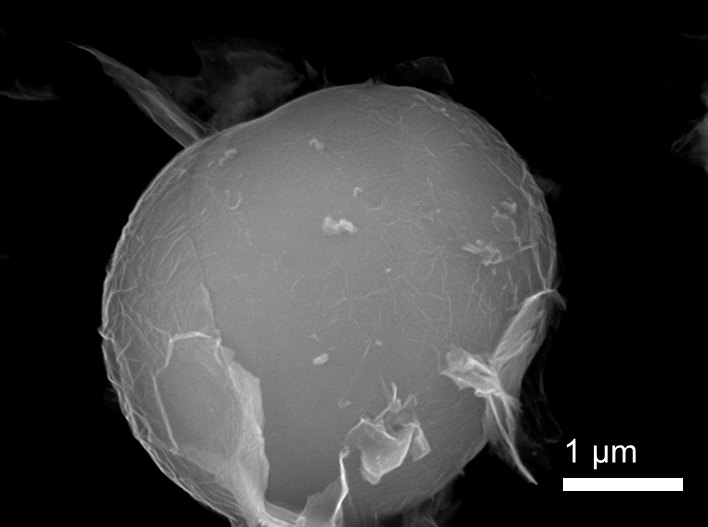
# These authors contributed equally to this work.



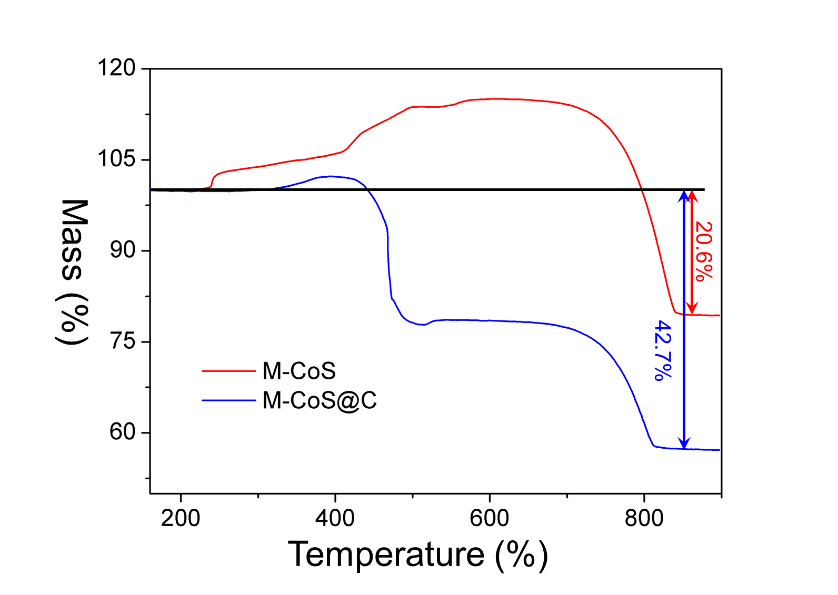
**Figure S1**. Physical and chemical characterization of the precursor. SEM image (a) and EDX spectrum (b) of the precursor. (c-e) Element mapping for the precursor. (f) FTIR spectra of thioacetamide, the precursor and CoS. (g) TGA result of the precursor.



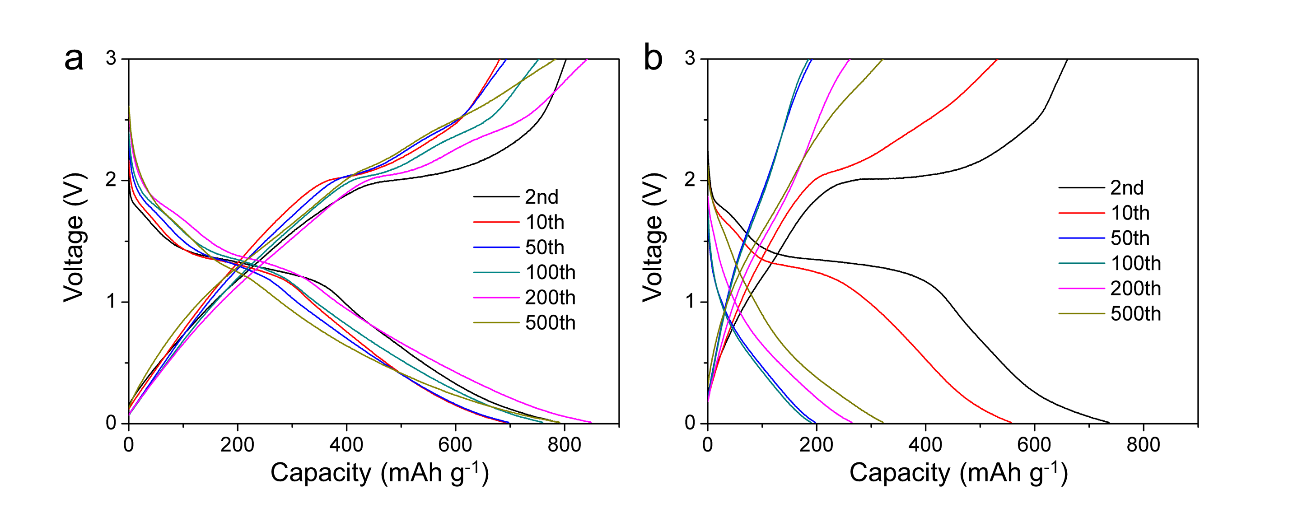
**Figure S2.** Morphology of the M-CoS. SEM (a, b) and TEM images (c) of the M-CoS. (c-e) Element mapping for the M-CoS.



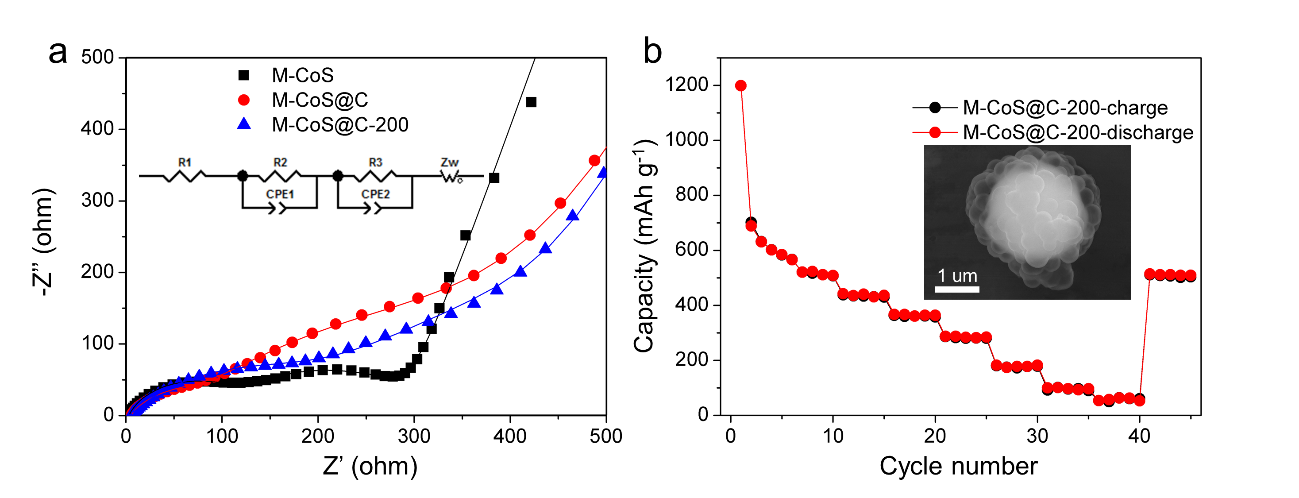
**Figure S3.** Morphology of the precursor@RF without the SiO2 layer.



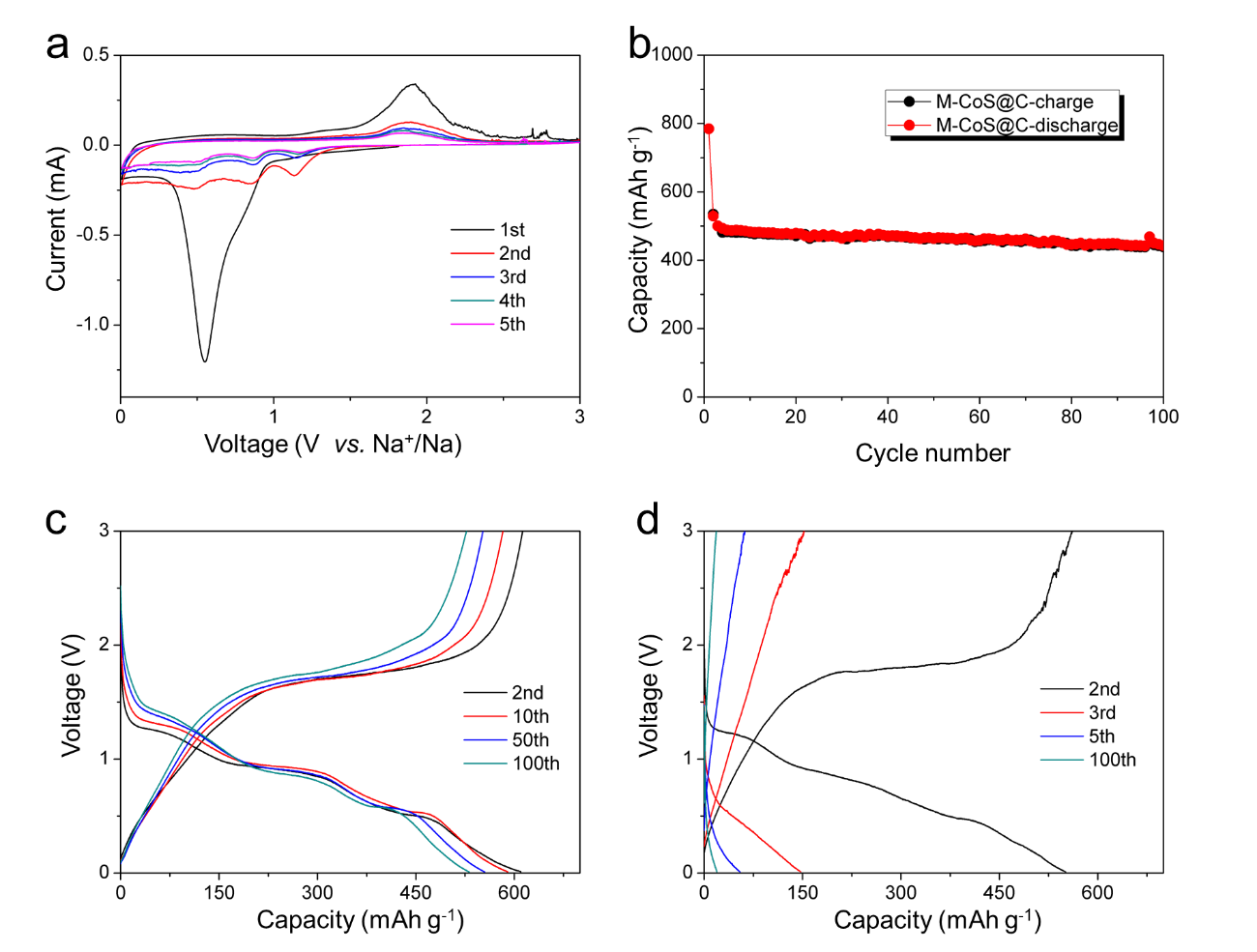
**Figure S4.** TGA results of the M-CoS and the yolk-shell M-CoS@C in air.



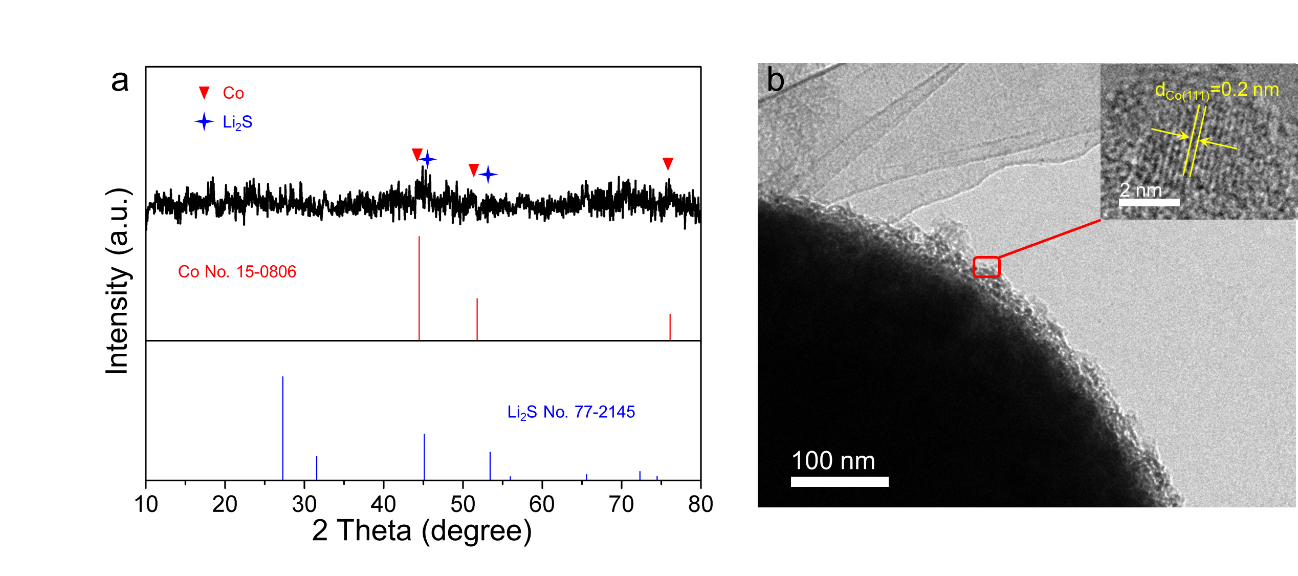
**Figure S5.** The corresponding discharge/charge curves of the yolk-shell M-CoS@C (a) and the M-CoS (b) at 1 A g-1 for LIBs.



**Figure S6.** (a) The impedance plots of the M-CoS, the yolk-shell M-CoS@C and M-CoS@C-200. (b) The rate performance of M-CoS@C-200 and its initial SEM image (inset).



**Figure S7.** (a) Cyclic voltammograms of the M-CoS at the scan rate of 0.2 mV s-1 between 0.01–3 V. (b) The cycling performance of M-CoS@C at 1 A g-1. The corresponding discharge/charge curves of the yolk-shell M-CoS@C (c) and the M-CoS (d) at 0.2 A g-1 for SIBs.



**Figure S8.** XRD pattern (a), TEM image (b) and HRTEM (inset) of the CoS electrode after first full discharging when applied in LIBs.