Supporting information

Implanting electrolyte additive on Single Crystal Ni-Rich Cathode surface for Improved Cycleability and Safety

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Table S1 Different amounts of the H_3BO_3 and $Al_2(C_2O_4)_3 \cdot xH_2O$ modifiers used in this study

Sample	H_3BO_3	$Al_2(C_2O_4)_3 \cdot xH_2O$	SC-NCM
1wt %	4.6 mg	11.9 mg	1.2 g
1.5wt %	7.0 mg	17.8 mg	1.2 g
2.0wt %	9.3 mg	23.7 mg	1.2 g

The ball-milled method: Using a spherical abrasive rod, grind $Al_2(C_2O_4)_3 \cdot xH_2O$ and H_3BO_3 for 1 hour, then, NCM powder is added into the mixture grind for 30 min grinding without using any solvents.

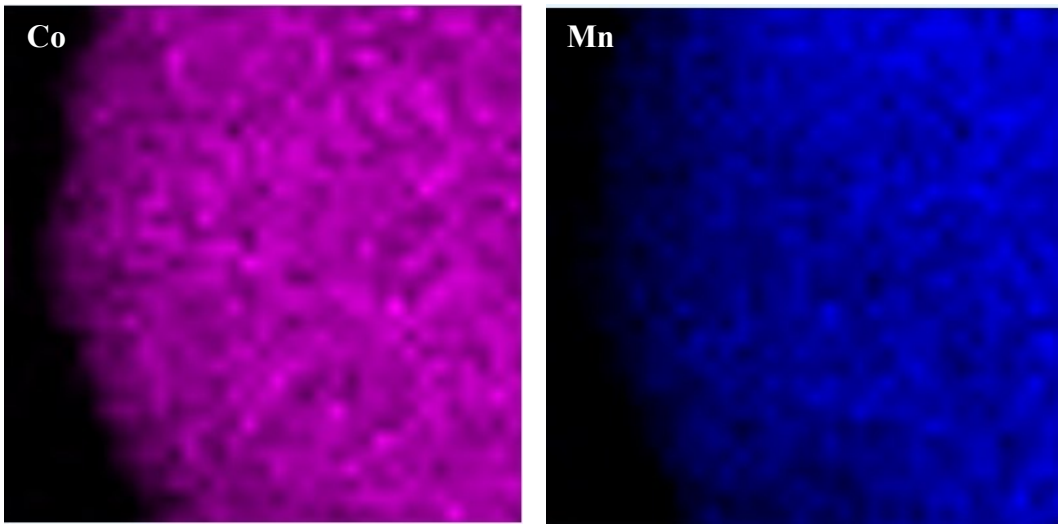

Fig. S1. Element distribution for Co and Mn elements in SC-NCM/AB sample

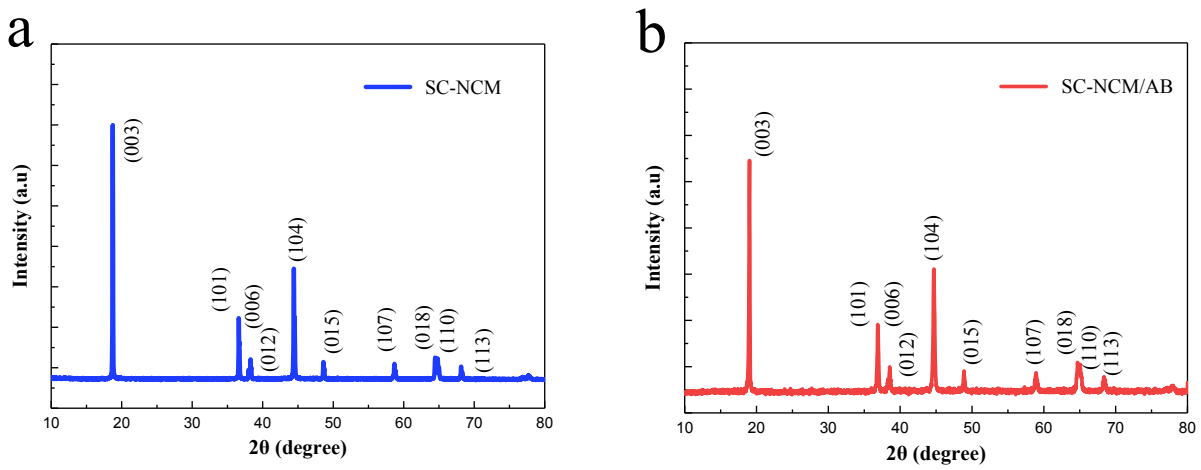

Figure S2 The XRD patterns for SC-NCM (a) and SC-NCM/AB (b).

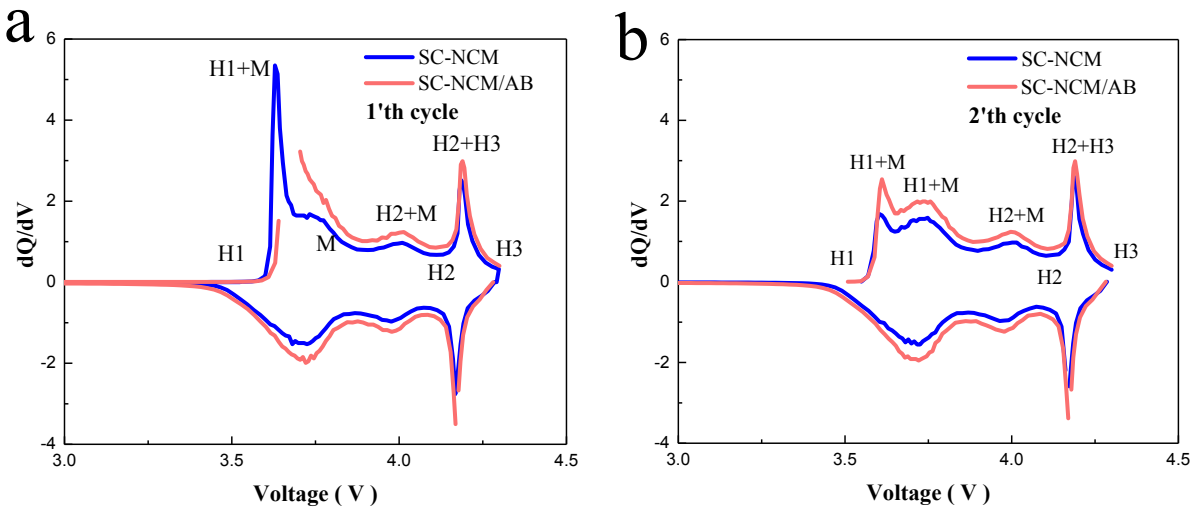

Figure S3 Electrochemical behavior for the SC-NCM and SC-NCM/AB samples: (a, b) dQ/dV curves *vs.* the cell voltage for the initial two cycles between 2.8-4.3 V.

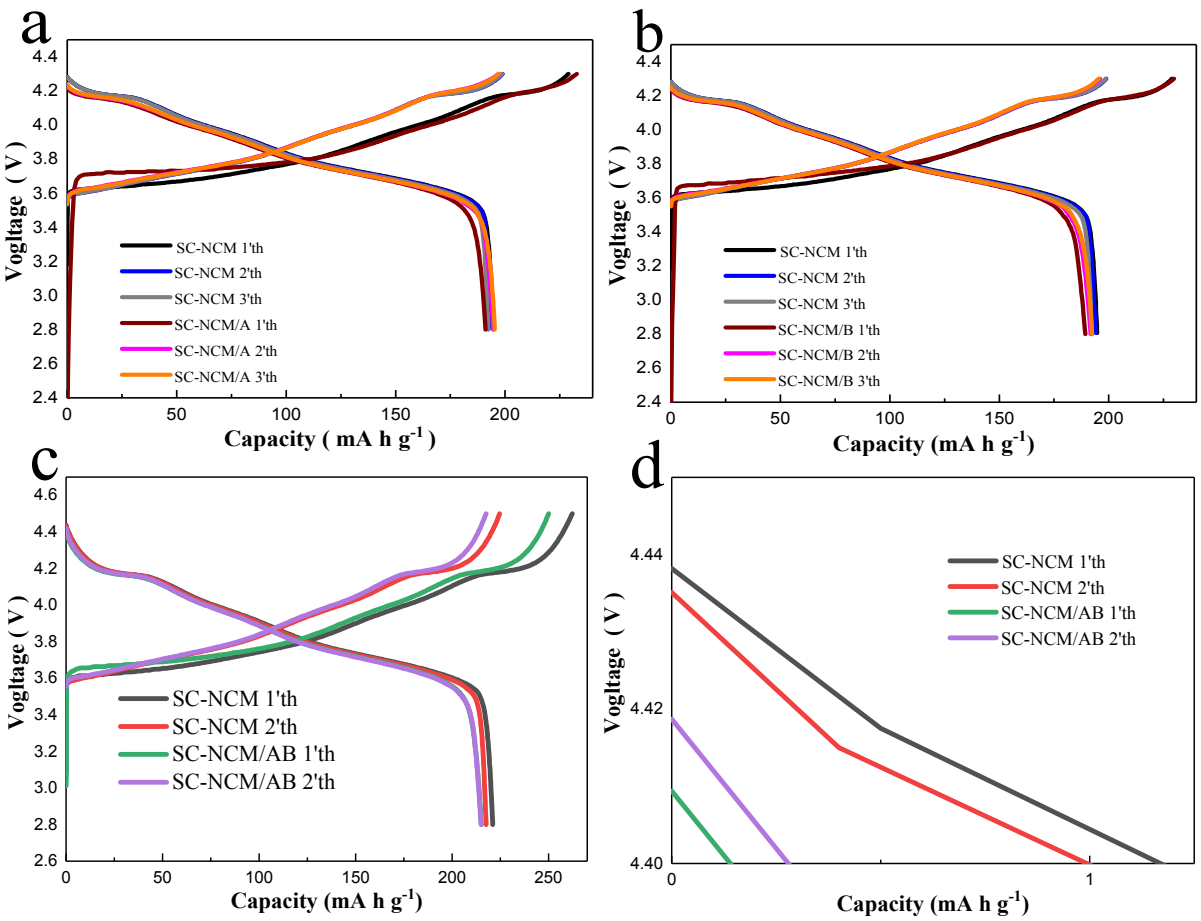

Figure S4 Electrochemical behavior for the SC-NCM, SC-NCM/A, SC-NCM/B and SC-NCM/AB samples: (a, b) the first three charge and discharge profiles at 0.1 C between 2.8 - 4.3 V at 25 °C for the SC-NCM/A and SC-NCM/B samples; (c, d) the first two charge and discharge profiles at 0.1 C between 2.8 - 4.5 V at 25 °C for the SC-NCM and SC-NCM/AB samples.

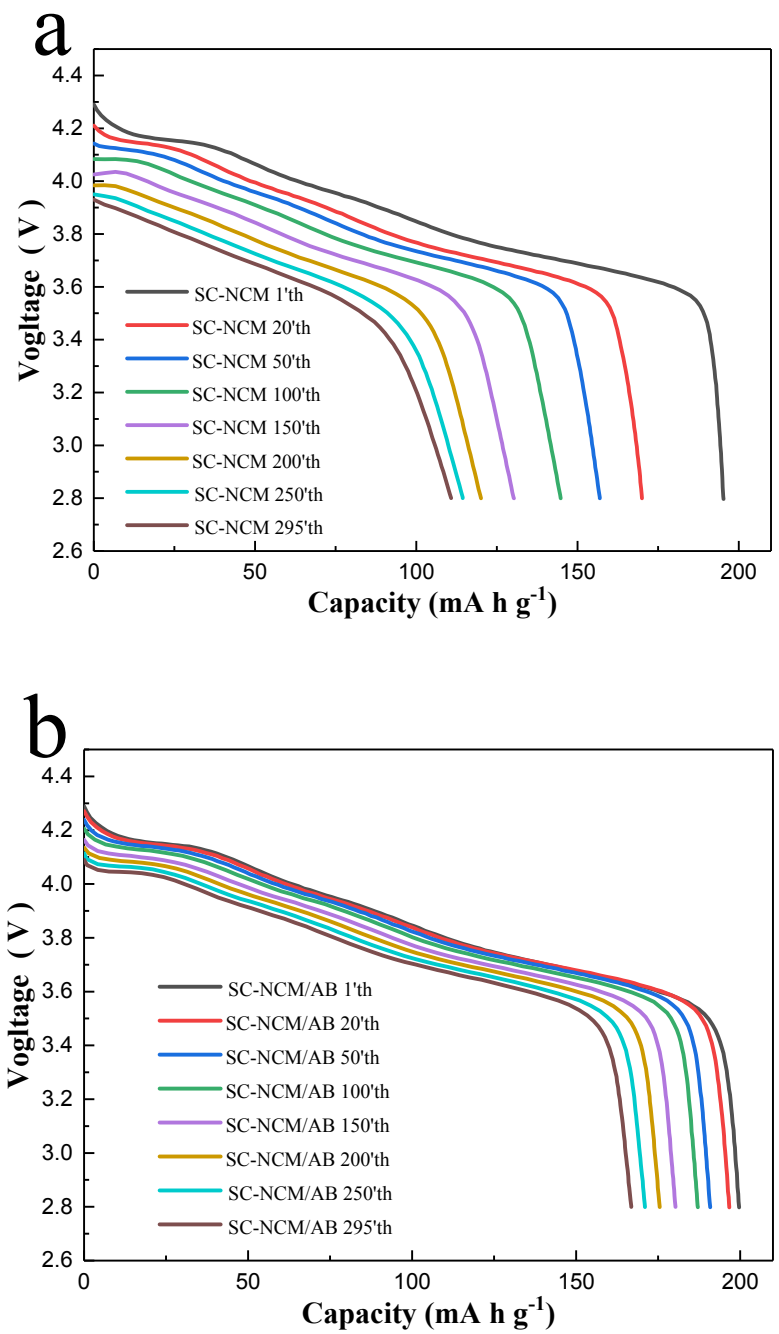

Figure S5. The discharge profiles between 2.8 - 4.5 V at 0.5 C for SC-NCM (a) and SC-NCM/AB (b), respectively.

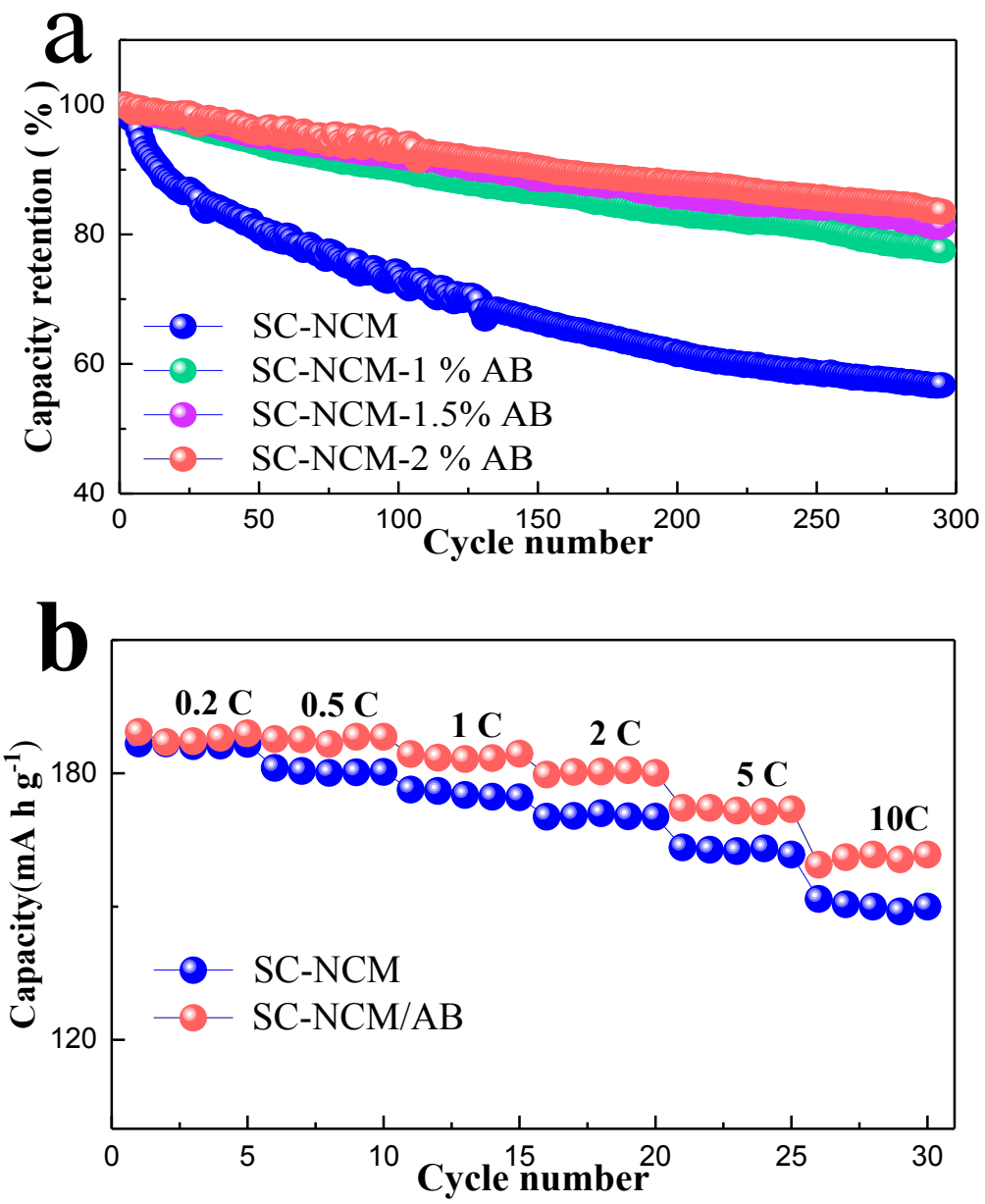

Figure S6. (a) Cycling behavior at 0.5 C rate between 2.8 - 4.5 V at 25°C with different account of Al(Li)BOB layer, (b) rate capability for SC-NCM and SC-NCM/AB.

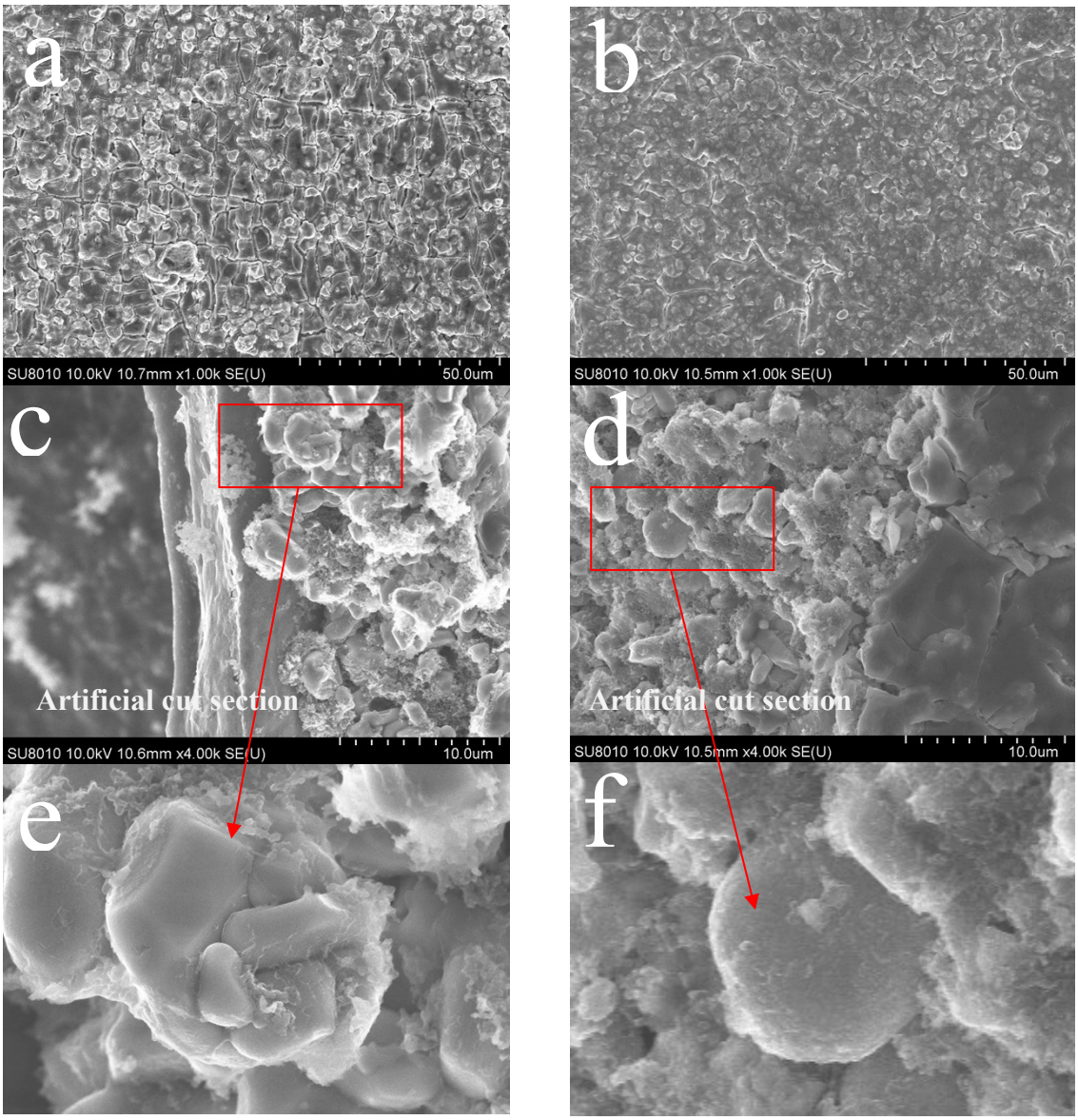

Figure S7. (a, b) SEM images of the SC-NCM and SC-NCM/AB after 295 cycles at 0.5 C between 2.8 - 4.5 V ; (c, d) SEM images of the SC-NCM and SC-NCM/AB in the artificial cut section after 295 cycles at 0.5 C between 2.8 - 4.5 V ; (e, f) the magnified image from the selected area of c and d, respectively.

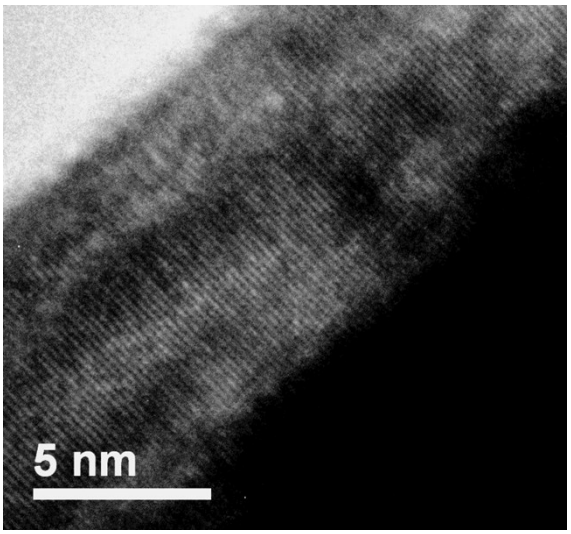

Figure S8. TEM images for the SC-NCM/AB sample before electrochemical cycle

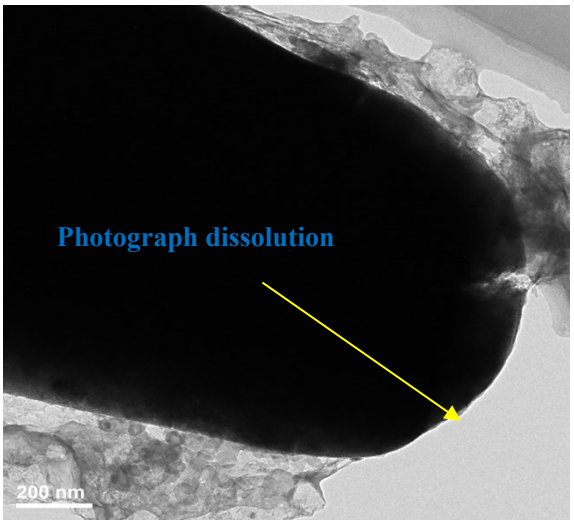

Figure S9. TEM images of the SC-NCM/AB focused on the CEI layer after 295 cycles at 0.5 C between 2.8 - 4.5 V .

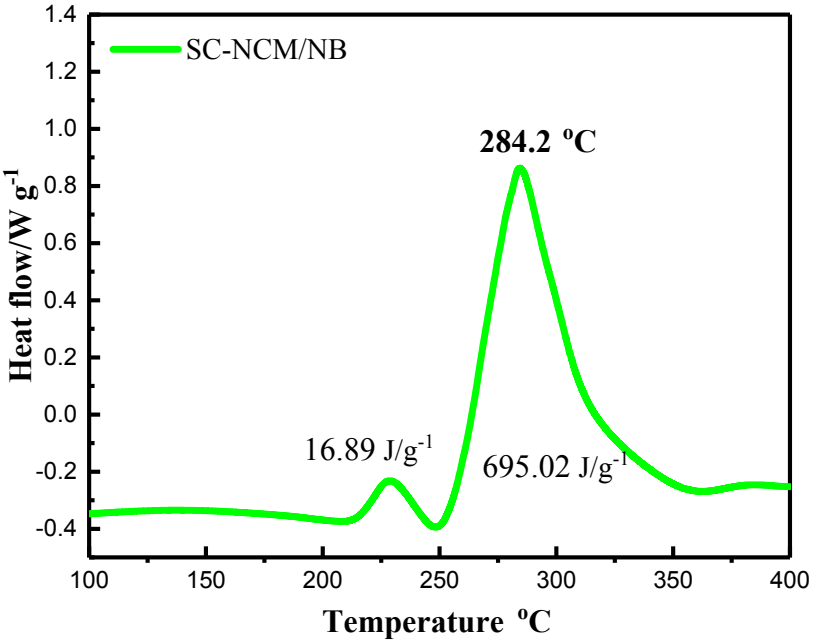

Figure S10 DSC curves of SC-NCM/NB sample