Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Electrochemical potassium-ion intercalation in Na_xCoO_2: A novel cathode material for potassium-ion batteries

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Characterization

The morphology of the final product was investigated by high resolution Scanning Electron Microscopy (FEI Inspect F50, operated at 5-20 kV). Following, the powder sample was properly dispersed in isopropyl alcohol. Few drops of sample was added on copper grid, which was used to record micrographs by the Transmission Electron Microscopy (FEI Tecnai F20 S-Twin unit, operated at 200 kV). XPS analysis was carried out for $Na_{0.84}CoO_2$ by a Kratos Axis Ultra DLD with an incident monochromated X-ray beam from the Al target. XPS data were collected at an accelerating voltage of 13 kV and mission current of 9 mA. Shift corrections were done by considering carbon as reference at 284.6 eV binding energy for all the samples.

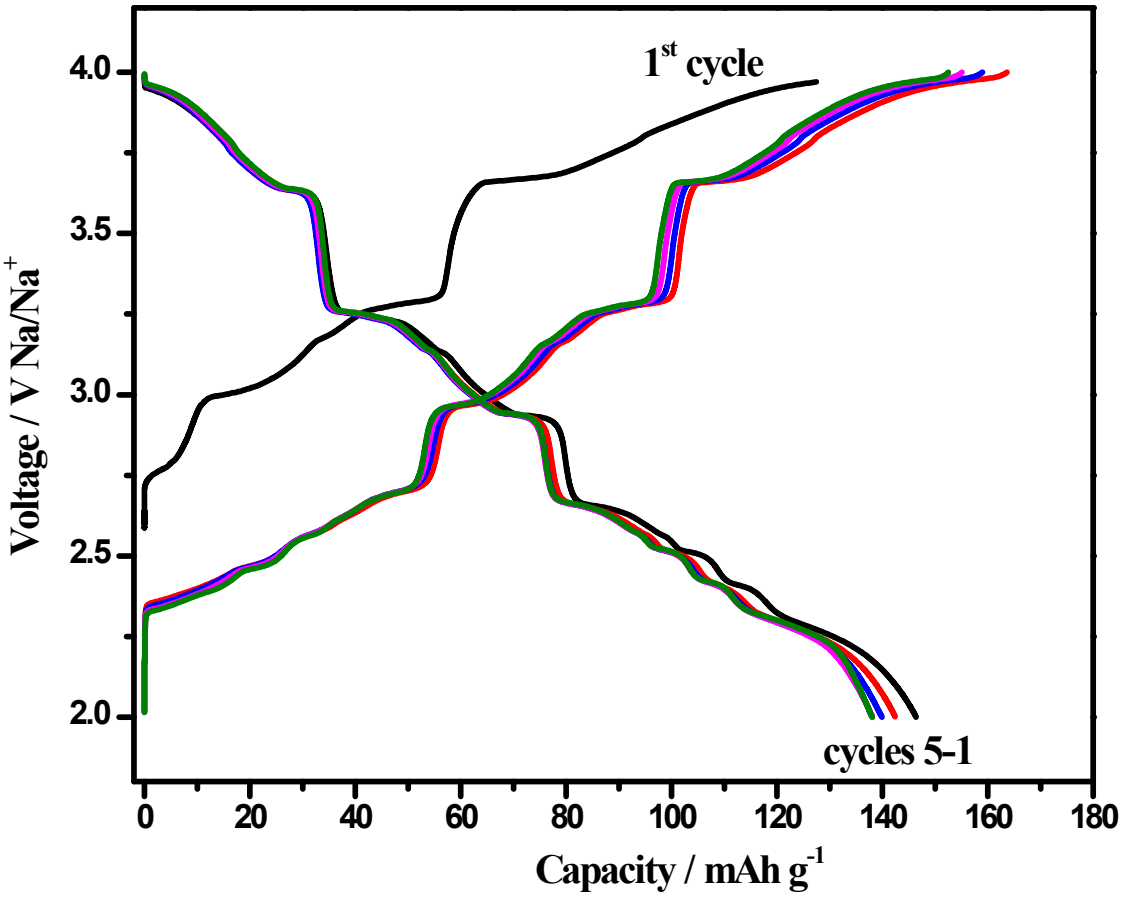

Figure S1. Charge-discharge curves of $Na_{0.84}CoO_2$ (Na-ion cell) at a current rate of C/20.

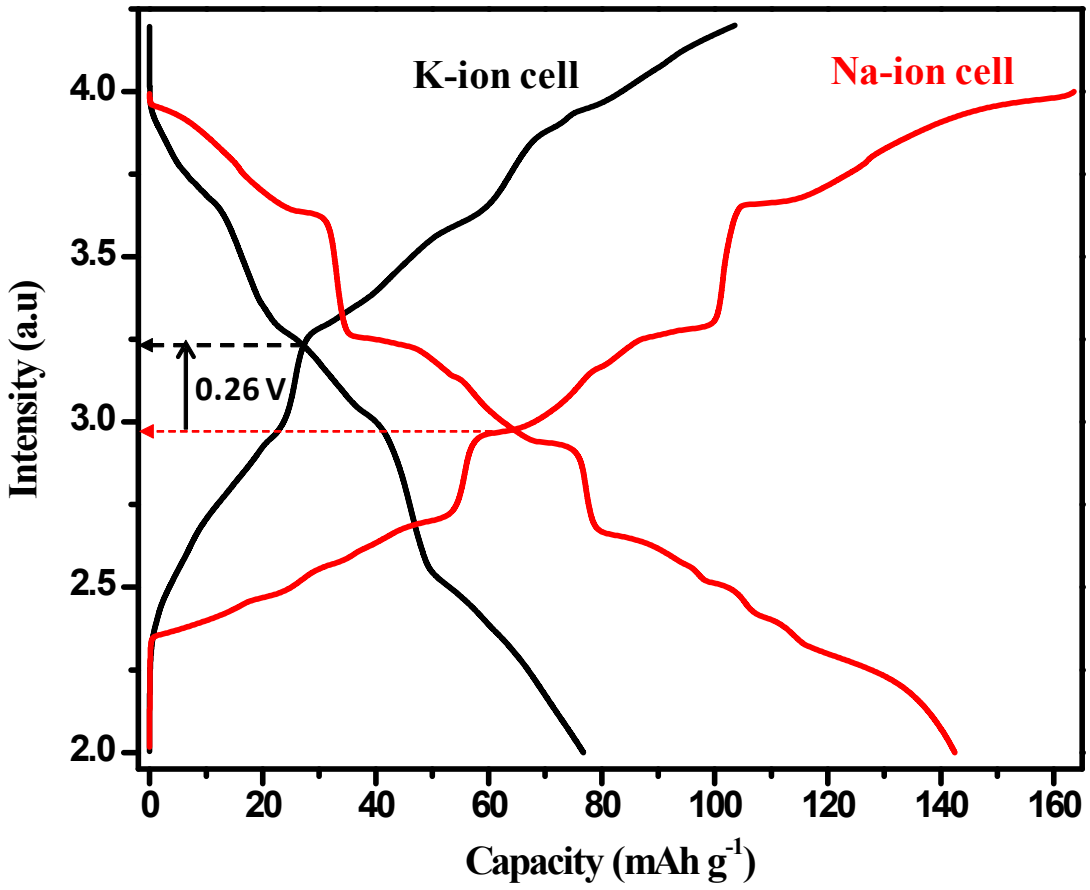

Figure S2. Comparative charge-discharge curves of $Na_{0.84}CoO_2$ in Na half-cell and K half-cell architecture at a current rate of C/20 (2^{nd} Cycle) and 0.26 V increase is evident in case of K-ion cell.

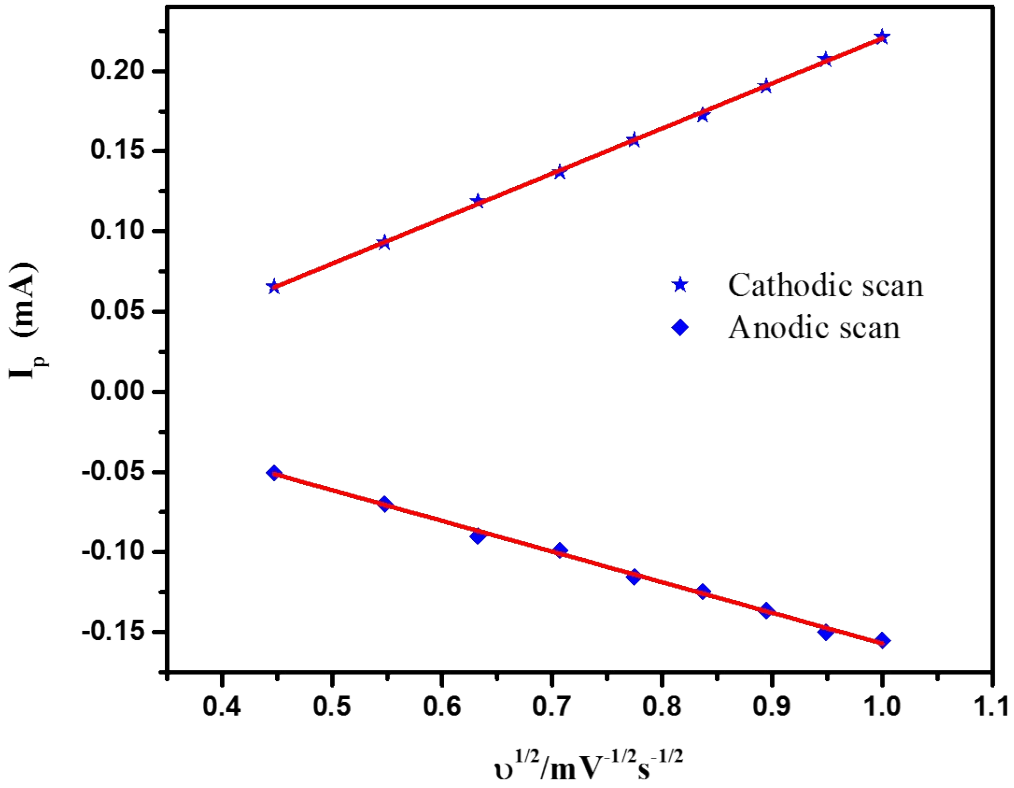

Figure S3: Plots of the peak currents (I_p) as a function of the square root of scanning rates ($v^{1/2}$) for both the cathodic and anodic processes.

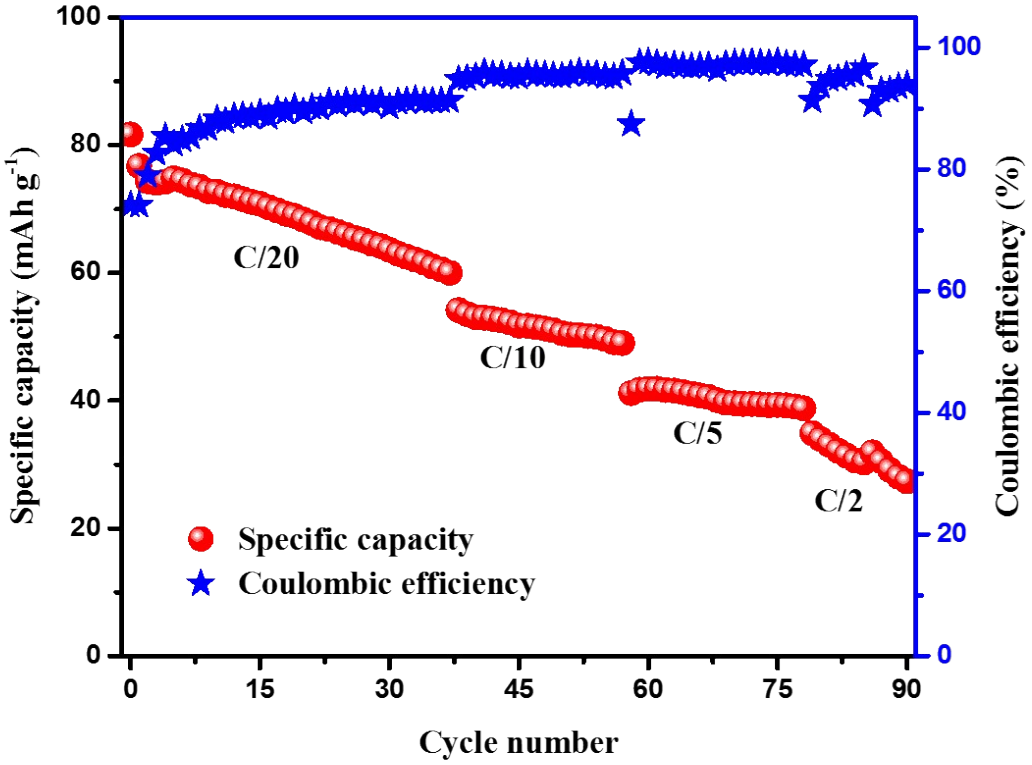

Figure S4: Cycling stability and coulombic efficiency of $Na_{0.84}CoO_2$ K-ion cell at different current density.

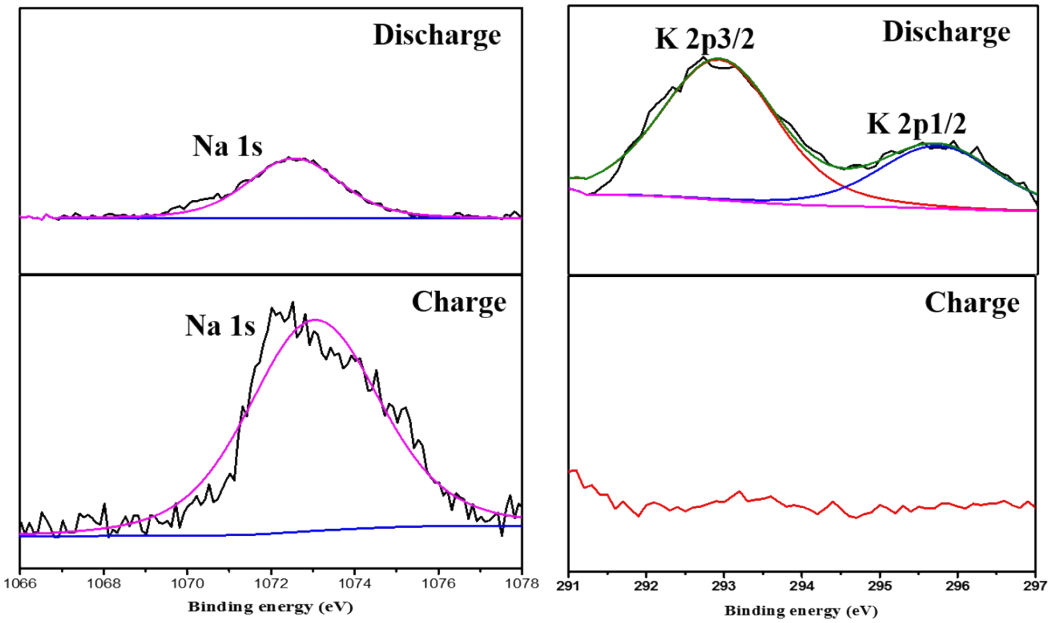

Figure S5: XPS spectra of Charged and Discharged electrodes of $Na_{0.84}CoO_2$ of K-ion cell. (Left) decrease in Na content upon discharge process. (Right) Presence of K during discharge process.

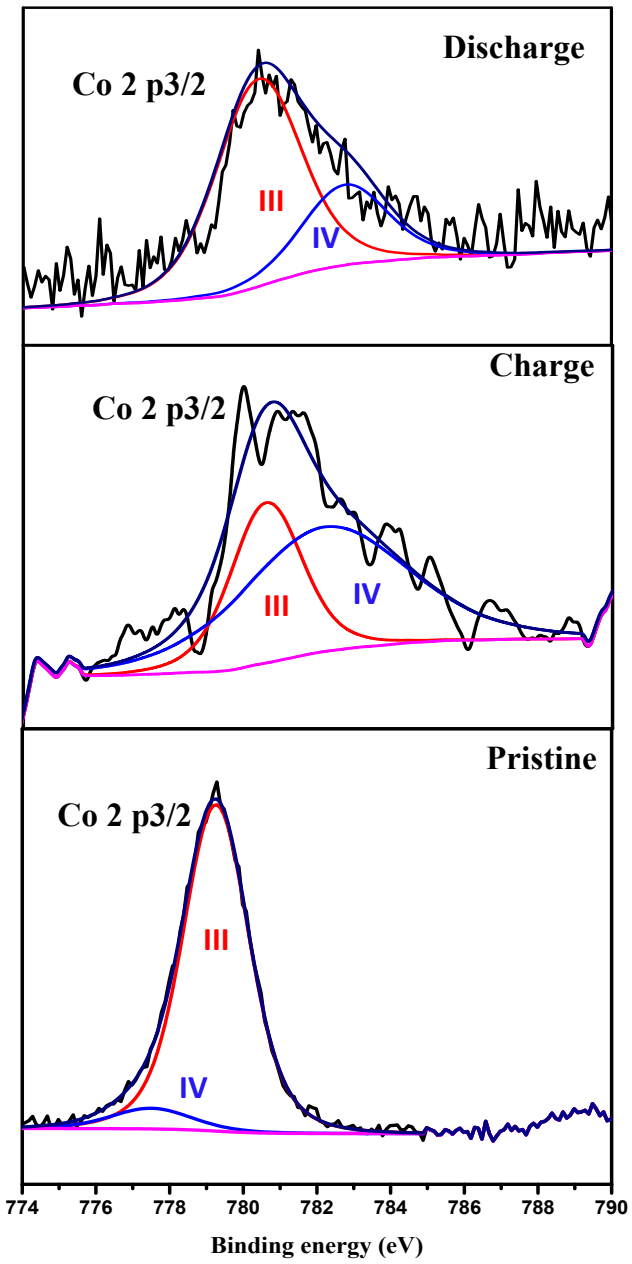

Figure S6: XPS spectra of Co 2p3/2 observance of reversible oxidation states of Co^{3+}/Co^{4+} during charge-discharge process.

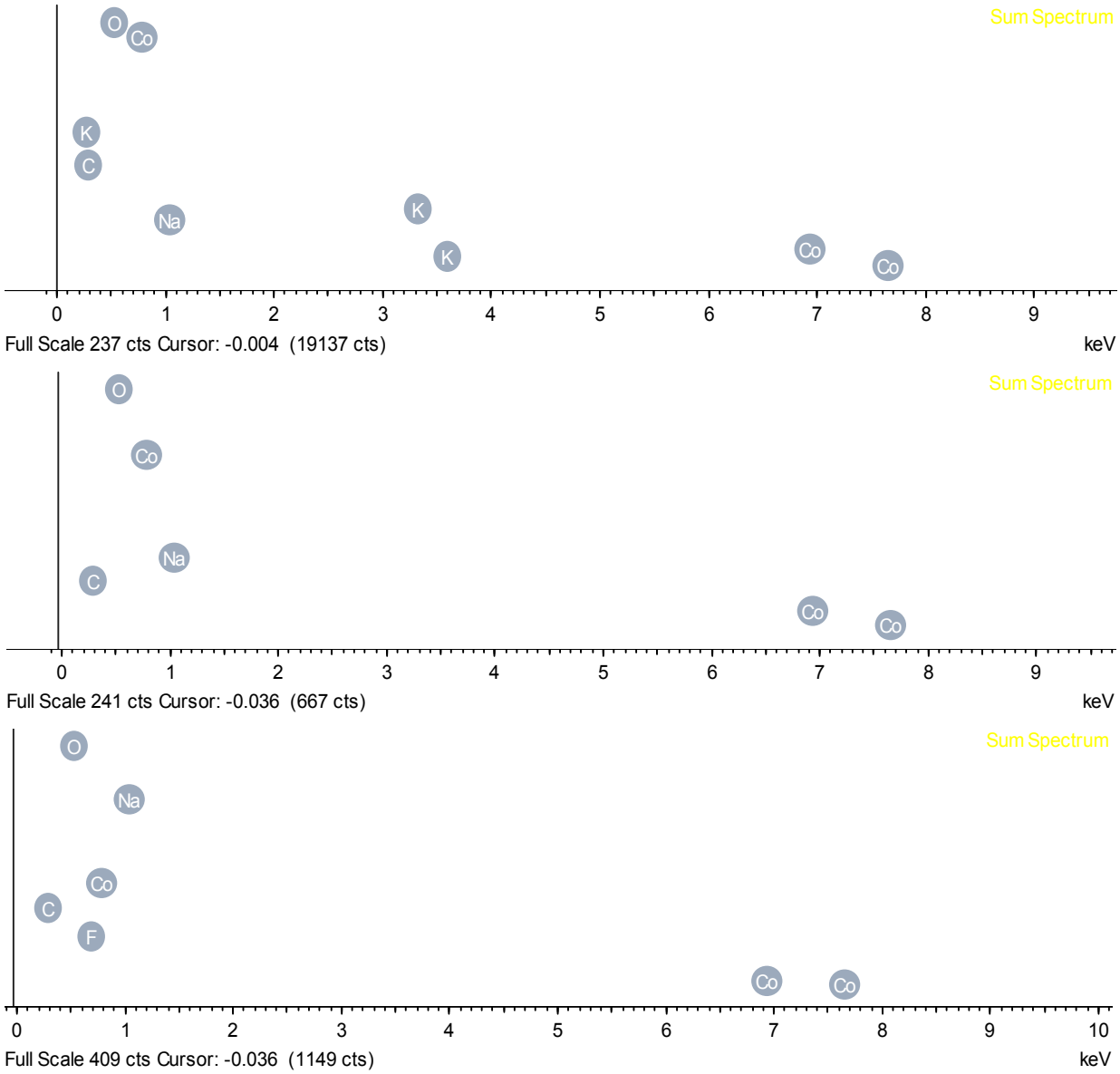

Figure S7. Comparative EDAX spectra of (a) pristine, (b) charged and (c) discharged $Na_{0.84}CoO_2$ electrodes. Decrease in Na concentration upon charge and observance of K peak during discharge process is observed.

Pristine:

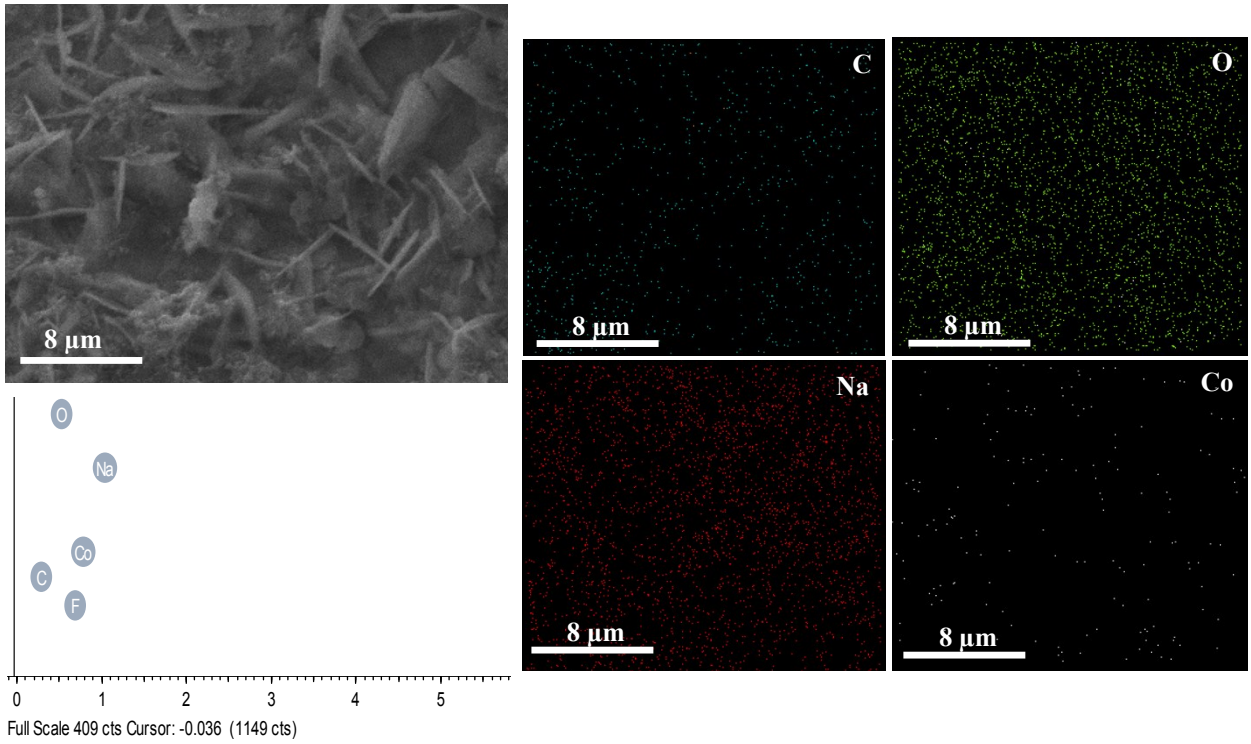

Figure S8. Elemental mapping images of pristine $Na_{0.84}CoO_2$ electrode showing uniform distribution of Na, Co and O.

Charged electrode:

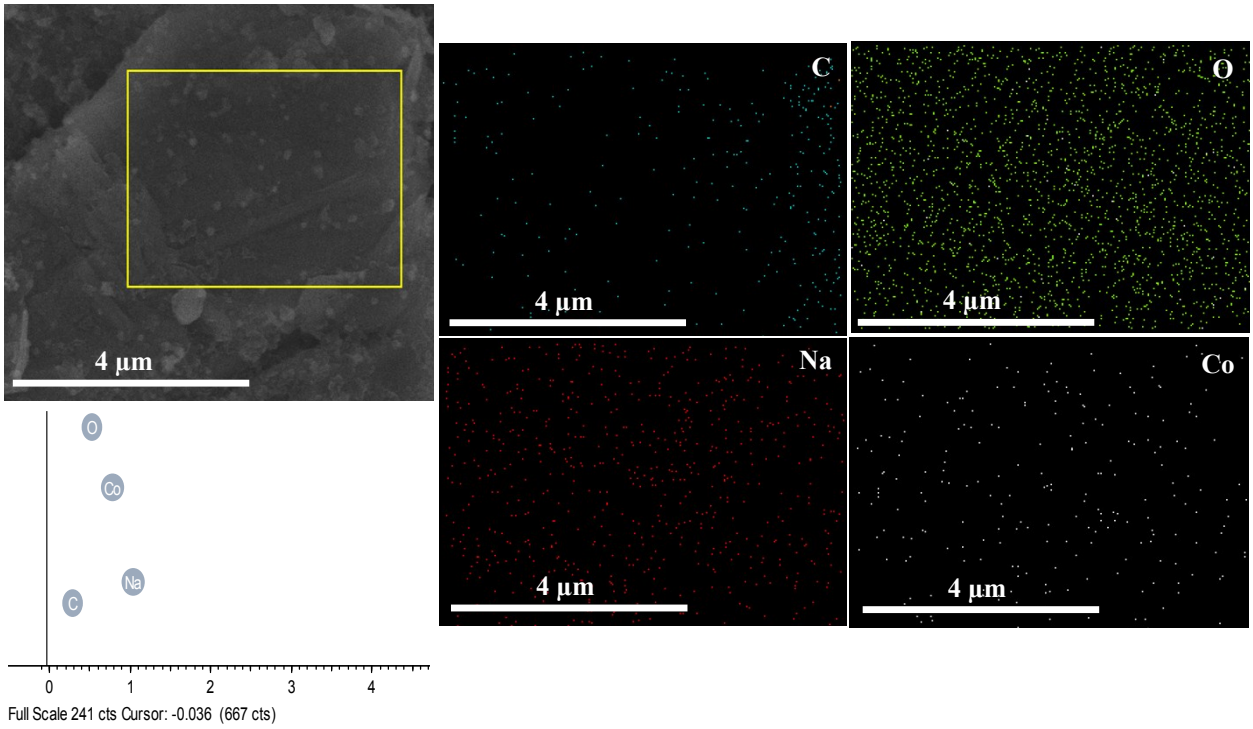

Figure S9. Elemental mapping images of fully charged $Na_{0.84}CoO_2$ electrode revealing decrease in Na content.

Discharged electrode:

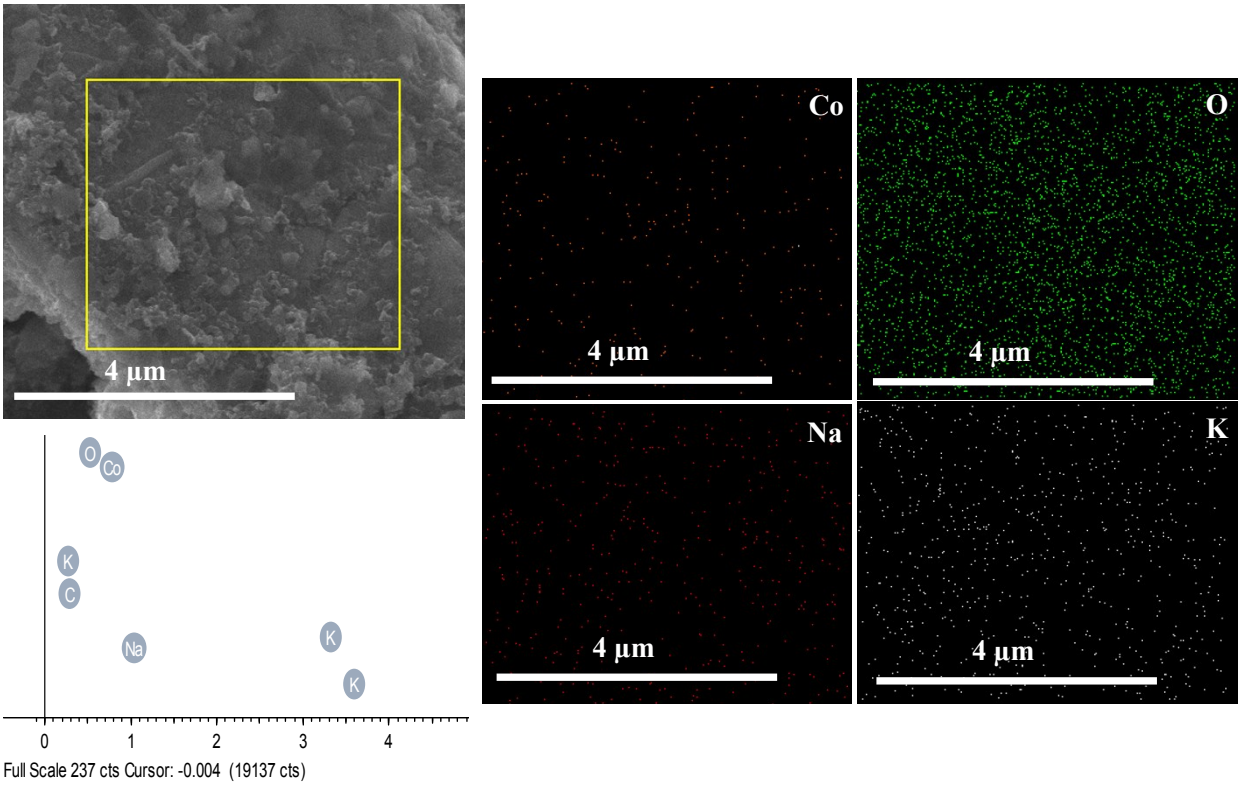

Figure S10. Elemental mapping images of fully discharged $Na_{0.84}CoO_2$ electrode proving the presence of K.

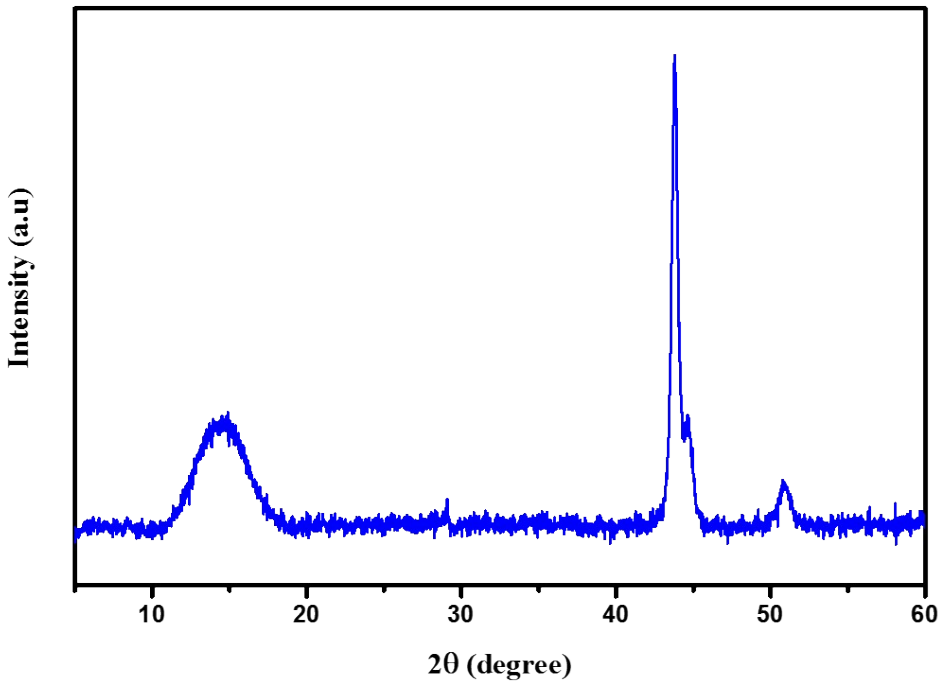

Figure S11: XRD pattern of the cell component (SS foil).