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Supplementary information

Advantageous Electrochemical Behaviour of New Core-Shell Structured Cathodes over Nickel-Rich Ones for Lithium-Ion Batteries

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Table S1. Electrochemical characteristics of initial cycles (0.1 C) for the synthesized cathodes.

Samples	**Charge capacity / mAh g^{-1}**	**Discharge capacity / mAh g^{-1}**	**Coulombic efficiency / %**	**Irreversible capacity loss / %**
NMC85	267	216	81	19
NR-CS	255	212	83	17
NR-LR	183	140	76	24

Table S2. Electrodes resistances parameters for NMC85, NR-CS and NR-LR electrodes extracted from the EIS measurements.

Electrodes	**R_s (Ω)**	**R_{sf} (Ω)**	**R_{ct} (Ω)**
NMC85	5.129	21.75	7844
NR-CS	6.770	37.15	2453
NR-LR	6.170	31.6	3419

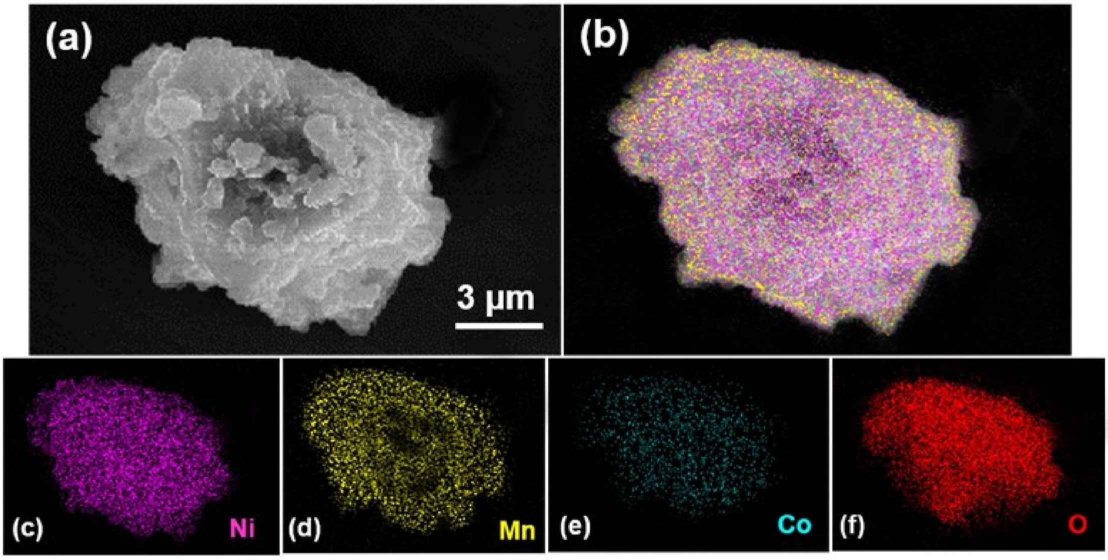

Fig. S1. HRSEM elemental mapping of NR-CS cathode, (a) NR-CS at 3 µm scale bar, (b) all elements, (c) Ni, (d) Mn, (e) Co, and (f) O.

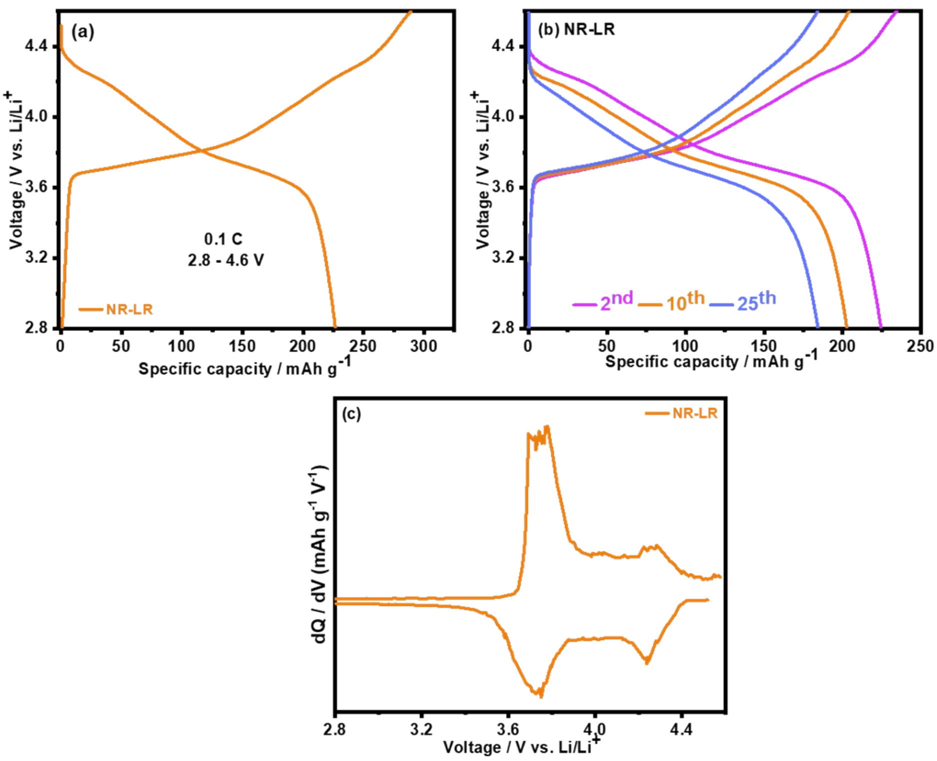

Fig. S2. Initial cycle, cycling & voltage profile for the 2nd, 10th, & 25th cycles and initial dQ/dV vs. V plot of NR-LR in the voltage range of 2.0-4.6 V at 0.1 C (25 °C).

Because of small proportion of Li-rich phase in the integrated material NR-LR, the high voltage activation plateau is not clearly observed as previously reported.[39]

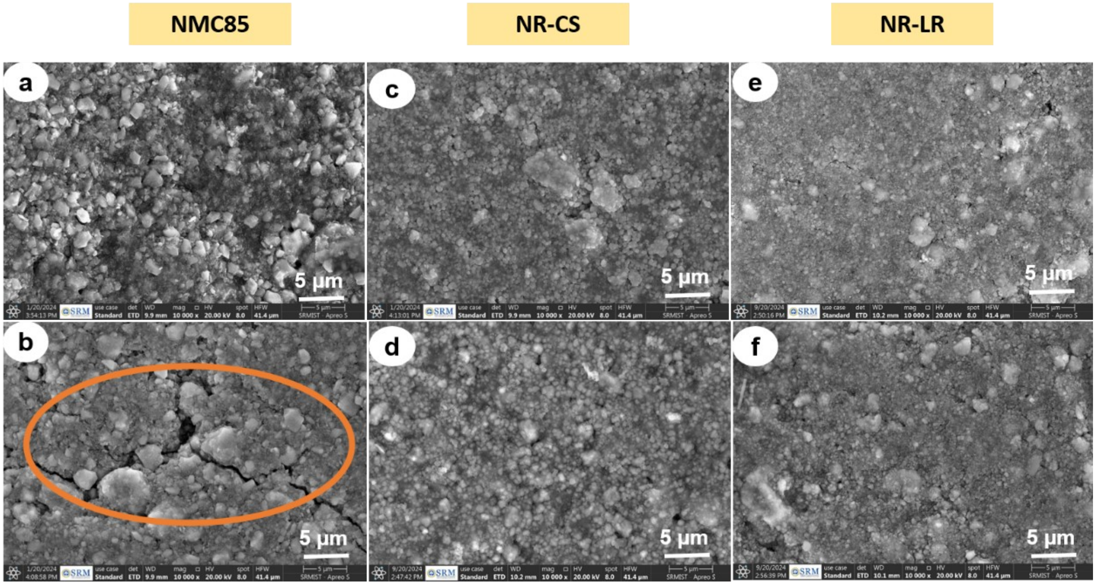

Fig. S3. SEM images of pristine (uncycled) and cycled (after 120 cycles) electrodes. Ni-rich NMC85 (a, b), NR-CS (c. d) and NR-LR (e, f). The scale bar is 5 µm.

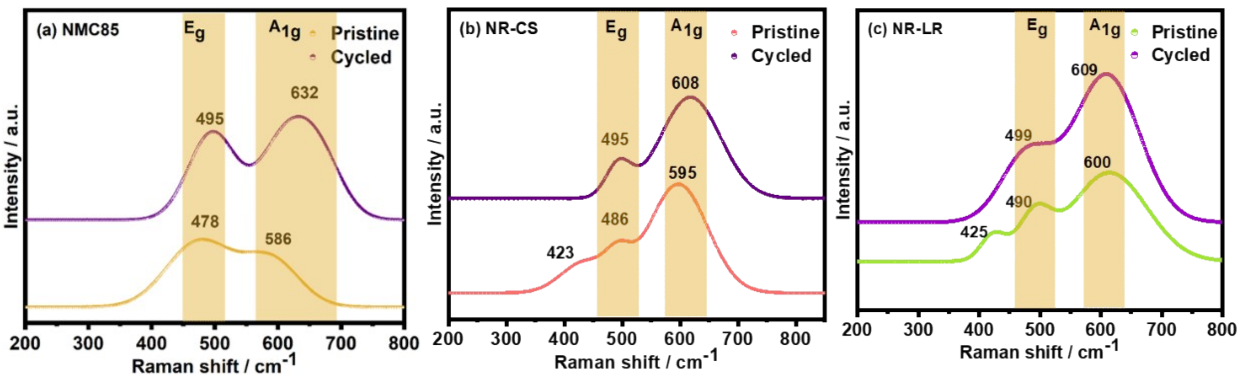

Fig. S4. Raman spectra of Ni-rich NMC85 (a), Ni-rich and Mn-based Li-rich NR-CS (b) and NR-LR (c) layered oxide cathodes: Pristine (uncycled) and cycled (after 120 cycles) electrodes as indicated.

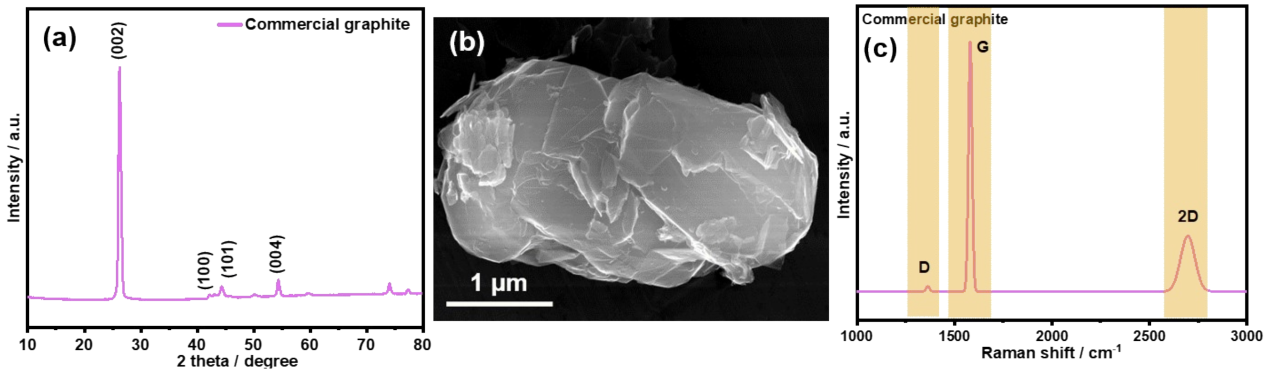

Fig. S5. Commercial graphite powder: (a) XRD pattern, (b) SEM images in the scale bar of 1 μm and (c) Raman spectra.