Supporting Information

Flame Aerosol Synthesis and Electrochemical Characterisation of Ni-rich Layered Cathode Materials for Li-ion Batteries

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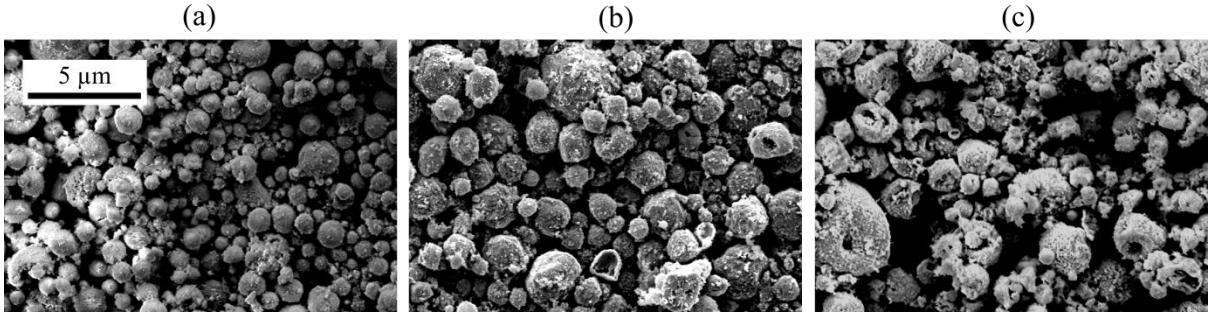

Figure S1 Particles synthesised from aqueous solutions of individual transition metal nitrate precursors at 0.5 mol L^{-1} concentration. (a) $Mn(NO_3)_2$; (b) $Ni(NO_3)_2$; and (c) $Co(NO_3)_2$.

Figure S1 shows particles synthesised from aqueous precursor solutions of individual metal nitrate (Mn, Ni and Co) precursors. The precursor concentration was fixed at 0.5 mol L^{-1} for each experiment. Solution droplets (diameter 3.5 µm) were generated using ultrasound and delivered to an electrically heated non-premixed coflow burner (15 mm inside diameter) operated with O_2, N_2 and CH_4 gases. The flame temperature (1350 K), preheating temperature (350 K) and O_2/CH_4 ratio (4.3) correspond to condition #1 used in the primary article.

Precursor solutions comprised of Mn nitrate produce predominantly spherical particles as shown in Figure S1a. Particles produced from Ni or Co nitrate solutions shown in Figure S1b and c respectively are noticeably larger and irregularly-shaped. The occurrence of cavities and broken shell-like structures indicates that these larger particles contain voids. This is caused by the earlier precipitation of lower solubility Ni and Co nitrate, supporting the point that solubility strongly affects the morphology. For direct comparison, in these experiments the precursor concentration was kept the same for every transition metal. The higher relative solution saturation of Ni nitrate in Ni-rich solutions acts to amplify this solubility effect.

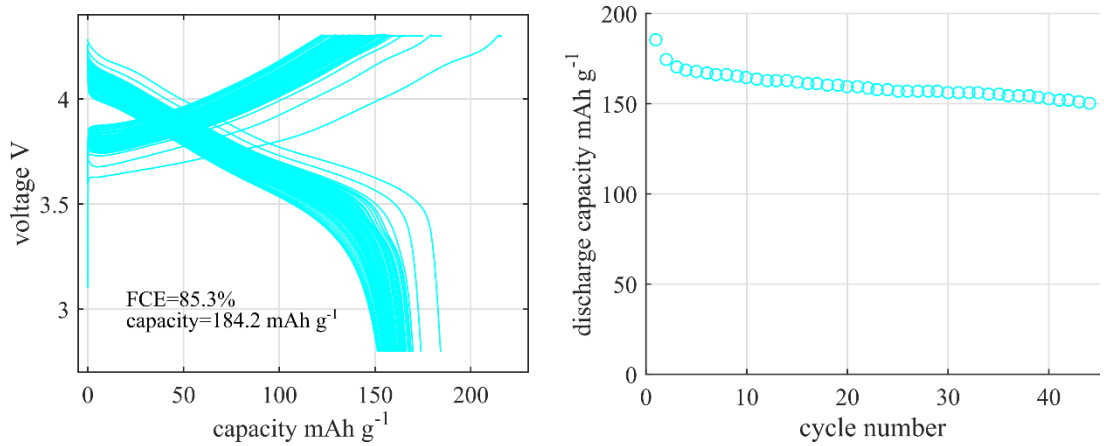

Figure S2 Electrochemical data for coin cell batteries assembled from NCM811 cathode materials synthesised at flame condition #3 (preheat temperature 450 K, flame temperature 1350 K). Left: Charge/discharge curves of single coin cell (45 cycles). Right: Average cycling behaviour (current density was 100 mA g^{-1} (0.5 C) in the voltage range of 2.8-4.3 V).