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Preparation of long-term cycling stable ni-rich concentration–gradient NCMA cathode materials for li-ion batteries

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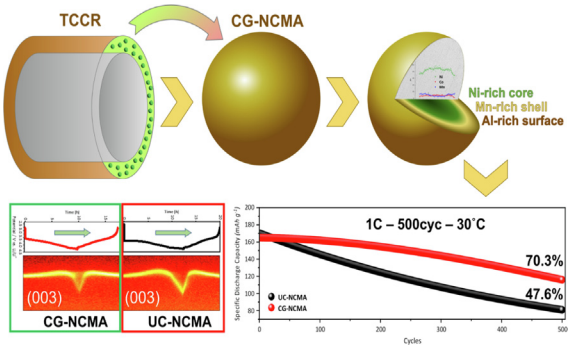
HIGHLIGHTS

- A double concentration-gradient (CG-NCMA) with a Ni-rich-core, an Mn-rich shell, and Al on top surface and uniform concentration (UC-NCMA) Li $[Ni_{0.90}Co_{0.04}Mn_{0.03}Al_{0.03}]O_2$ was synthesized by using a continuous co-precipitation Taylor–Couette cylindrical reactor (TCCR).
- The two concentration gradient structures were confirmed using cross-section line scanning using FIB and EDX.
- The cathodes were extensively investigated through *in situ* XRD, TEM, XPS, and EIS and exhibited superior structural strength and electrochemical performances.
- The capacity retention for CG-NCMA cathode at 1C (200 mA g^{-1}) after 100 cycles is 91.5 %, as compared to 83.4 % of UC-NCMA.
- *In-situ* XRD study showed that the CG-NCMA cathodes undergo less mechanical strain and stay robust under high voltages, as compared to UC-NCMA; and it was confirmed by post-mortem SEM and TEM analysis.

GRAPHICAL ABSTRACT



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ABSTRACT

Nickel-rich (Ni > 90 %) cathodes are regarded as one of the most attractive because of their high energy density, despite their poor stability and cycle life. To improve their performance, in this study we synthesized a double concentration-gradient layered Li$[Ni_{0.90}Co_{0.04}Mn_{0.03}Al_{0.03}]O_2$ oxide (CG-NCMA) using a continuous co-precipitation Taylor–Couette cylindrical reactor (TCCR) with a Ni-rich-core, an Mn-rich surface, and Al on top. The concentration-gradient morphology was confirmed through cross-sectional

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