

Quaternary Layered High Ni NCMA Cathode for High-Energy density lithium ion batteries

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Li[Ni_{1-x-y}Co_xAl_z]O₂ (NCA) and Li[Ni_{1-x-y}Co_xMn_y]O₂ (NCM) cathodes have been the archetypes of current high-energy density cathodes for Li-ion batteries. A hybrid of NCA and NCM cathodes, a quaternary system consisting of Li[Ni_{0.89}Co_{0.05}Mn_{0.05}Al_{0.01}]O₂ (NCMA) was benchmarked against NCM and NCA with similar Ni contents. The quaternary NCMA cathode delivered a capacity of 228 mAh g⁻¹ and outperformed the benchmarking cathodes in long-term cycling stability (85% after 1000 cycles). The reduction in the volume change during deintercalation and the enhanced intrinsic mechanical strength confirmed by the single particle compression test suppressed the microcrack nucleation and propagation. Microcrack suppression was important because microcracks serve as channels for electrolyte infiltration and lead to the subsequent surface degradation of internal surfaces. The proposed NCMA cathode provides extra cycling stability which is essential for electric vehicles, which require a long battery life and improves the thermal stability of the cathode, which contributes to a safer battery.