Next generation High nickel Core-Shell structure Cathode ($Li[Ni_{0.95}Co_{0.025}Mn_{0.025}]O_2$) for Long term cycling and High-Energy Density Lithium-Ion Batteries

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A core-shell structured cathode with a $LiNiO_2$ core and $Li[Ni_{0.8}Co_{0.1}Mn_{0.1}]O_2$ shell, resulting in an average composition of $Li[Ni_{0.95}Co_{0.025}Mn_{0.025}]O_2$, was synthesized via the co-precipitation method. The core material, $LiNiO_2$, designed to maximize the specific capacity, was protected by a 500-nm-thick encapsulating $Li[Ni_{0.87}Co_{0.065}Mn_{0.065}]O_2$ shell layer to improve the structural stability. The core-shell cathode delivered an initial discharge capacity of 235.7 mAh g^{-1} at 0.1 C (18 mA g^{-1}) and 90% of its initial capacity was maintained after 100 cycles at 0.5 C (90 mA g^{-1}), whereas the capacity retention of the $LiNiO_2$ cathode without the protective shell was limited to 74.2% after 100 cycles.[1,2] The improved cycling stability of the core-shell cathode was also verified in a full cell test (against graphite anode at 1 C) in which the CS cathode also clearly outperformed the $LiNiO_2$ cathode. The improved cycling performance is mainly attributed to stabilization of the inherently reactive $LiNiO_2$ surface by the Ni-depleted protective shell layer.[3] The proposed core-shell approach allows harnessing of the high capacity of $LiNiO_2$ and other extremely Ni-rich compositions with dramatically improved capacity retention, thus moving closer to satisfying the high-energy density and long lifetime requirements for lithium-ion batteries for electric vehicles.[4]

Reference

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