The Microstructure Designed Ni-Rich Cathode Material for Improving Mileage of Next Generation Electric Vehicles

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A multi-compositional particulate $Li[Ni_{0.9}Co_{0.05}Mn_{0.05}]O_2$ cathode is synthesized using a differential coprecipitation process in which $Li[Ni_{0.94}Co_{0.038}Mn_{0.022}]O_2$ at the particle center is encapsulated by a 1.5 μm thick concentration gradient (CG) shell with the outermost surface composition $Li[Ni_{0.841}Co_{0.077}Mn_{0.082}]O_2$. The microscale compositional partitioning at the particle level combined with the radial texturing of the refined primary particles in the CG shell layer protracts the detrimental H2 → H3 phase transition, causing sharp changes in the unit cell dimensions. The protraction markedly improving cycling performance and thermochemical stability as compared to conventional cathode which has equivalent composition. Thus, the proposed cathode material provides an opportunity for the rational design and development of a wide range of multifunctional cathodes, especially for Ni-rich $Li[Ni_xCo_yMn_{1-x-y}]O_2$ cathodes, by compositionally partitioning the cathode particles and thus optimizing the microstructural response to the internal strain produced in the deeply charged state.