Heuristic approach for achieving outstanding cycling stability for High energy density Ni-rich layered cathode materials

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The partial substitution of Ni in $Li[Ni_{0.90}Co_{0.09}M_{0.01}]O_2$ (M: dopant) with different elements results in a wide variety of microstructures, ranging from highly oriented needle-like columnar primary particles to randomly oriented equiaxed primary particles. This enables the precise tailoring of the shape and orientation of the constituent particles of Ni-rich layered cathodes. Based on the survey results of different doping elements (Mn, Al, B, Sb, W, Nb, Mo, and Ta)[1,2], it is heuristically determined that $Li[Ni_{0.90}Co_{0.09}Ta_{0.01}]O_2$ cathode exhibits the optimal microstructure and crystal structure conducive to long-term cycling stability (90% retention capacity after 2000 cycles)[3-5], while providing a high capacity at full depth of discharge. The capacity and cycling performances exhibited by the $Li[Ni_{0.90}Co_{0.09}Ta_{0.01}]O_2$ cathode with an expected energy density provide a solution for overcoming the inherent hurdle of the Ni-rich layered cathode, meeting the demands for the next generation of electric vehicles.

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2. *ACS Energy Lett.* **4**, 576 (2019).
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