**Influence of precursor, crystal and microstructure on electrochemical performance of LiNiO2 cathode material**

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The demand for reliable energy storage devices, driven by renewable energy sources, has spurred the quest for fast-charging, lightweight, and dependable storage technologies. Lithium-ion batteries (LIBs) have emerged as the preferred power sources for consumer electronics, renewable energy plants, and sustainable vehicles [[1](https://doi.org/10.1038/s41467-020-18736-7)]. Cathode materials play a pivotal role in LIBs, significantly influencing their electrochemical performance and cost [[2](https://doi.org/10.1016/j.jpowsour.2013.09.052)]. Ni-rich layered oxides exhibit promising electrochemical properties, including high reversible specific capacity and energy density. Despite progress, finding the optimal approach remains elusive due to trade-offs among different electrochemical characteristics.

This study aims to investigate the synthesis techniques for LiNiO2 to achieve improved electrochemical stability while maintaining high energy density. Precursor preparation, involving α and β-Ni(OH)2, along with high-temperature lithiation and thorough characterization, constitute essential steps in the optimization process. α-Ni(OH)2 typically forms under specific conditions and exhibits distinct structural and chemical properties compared to β-Ni(OH)2, which is more commonly encountered and has practical applications in various fields [3]. In the investigation of LiNi0.6Mn0.2Co0.2O2, it has been demonstrated that the cathode material synthesised from a blend of α- and β-phases precursors exhibits superior electrochemical characteristics, notably the highest discharge capacity and optimal rate performance[4]. Based on these results, we propose the possibility of obtaining LiNiO2 cathode material with enhanced electrochemical performance through direct control of the precursor (α- or β-Ni(OH)2) crystal structure. It also includes the development and optimization of synthesis conditions, characterization of crystal structure and morphology, optimization of lithiation conditions, and correlation of synthesis parameters with material performance. The obtained polycrystalline samples were investigated by powder X-ray diffraction (PXRD), scanning and transmission electron microscopy (SEM, TEM).

## *The work was carried out with the support of RSF 23-73-30003.*

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