Development of a Co-free Li-rich layered oxide material to use as positive electrode in Li-ion batteries.

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Development of new materials for Li-ion batteries is mandatory to satisfy the increasing demand for energy storage systems with high capacity, large energy density, remarkable cycle life stability and excellent safety. Up to now, the cathode side is a key-bottleneck to further push the performance of the lithium ion batteries (LIB).[1]

In this context, Li-rich transition metal layered oxides (LRLO) is a very interesting class of materials to use as cathode for Li-ion batteries (LIBs) thanks to their higher specific capacities (>250mAh/g) and larger operating voltage (>3.6V), compared to the actual cathodes used in the commercial LIBs.[2]

LRLOs have a generic formula $Li_{1+x}M_{1-x}O_2$, in which M is a mix of redox active transition metal as Ni, Mn or Co. Lithium is overstoichiometric and partially occupy atomic sites of transition metals.

Nevertheless, besides the performance, the materials for next-generation LIBs have to satisfy further requirements such as low cost and sustainability for example by the mitigation of the Co and Ni content in the overall stoichiometry.[3,4] Among the family of LRLO materials, Co-free stoichiometries have been already reported in the literature. The most studied one is the $Li_{1.2}Mn_{0.6}Ni_{0.2}O_2$, reported for the first time by Thackeray's group.[5]

Here, we propose a Co-free LRLO material with reduced content of nickel that maintain the layered structure characteristic of this type of materials and, especially, good electrochemical performance in lithium cell. The material here proposed has been characterized in terms of structure and morphology, while the electrochemical properties have been demonstrated in lithium half-cells by galvanostatic cycling.

References

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