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Influence of the $\text{LiNi}_{0.6}\text{Mn}_{0.2}\text{Co}_{0.2}\text{O}_2$ (NMC 622) layered oxide morphology on the positive electrode/electrolyte interface

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The $\text{LiNi}_{0.6}\text{Mn}_{0.2}\text{Co}_{0.2}\text{O}_2$ layered oxide is a very attractive positive electrode material for Li-ion batteries and possibly in a near future for all-solid-state batteries, thanks to good capacity, stability and cyclability upon long range cycling in the former. To optimize its performances in both systems, a better knowledge of its reactivity, versus liquid and solid electrolyte, is needed. The aim of this work is to tailor its morphology, particle size and shape, in order to determine their impact on the reactivity. A series of samples with crystallographic structure close to the ideal 2D layered structure (less than 5% Ni^{2+} ions into the Li^+ sites) and the targeted composition were obtained by a two-step synthesis, consisting of a coprecipitation followed by a solid-state reaction. Samples with primary particle sizes from 200 nm to 2 μm were obtained by varying the solid-state reaction temperature and atmosphere. Samples with platelet-shaped particles were obtained by using a large amount of ammonium hydroxide as template during the coprecipitation step. Two thicknesses, around 10 nm and 85 nm, were obtained by varying the thermal treatment temperature. Electrochemical tests, as well as XPS and Auger analyses were performed to characterize the electrochemical performance and surface properties of the materials. Analyses were also performed after cycling to study the electrode/electrolyte interface and compare the reactivity of the materials as a function of their morphology. These results will be discussed in details in the frame of this communication.

Keywords: battery, layered oxide, NMC, morphology, reactivity, performance