Westfälische Wilhelms-Universität Münster
Department of Chemistry and Pharmacy
Institute of Physical Chemistry

Study of Layered Transition Metal Oxides as Cathode Materials for Sodium-Ion Batteries: Linking Structural and Electrochemical Properties

Luciana Gomes Chagas

Sodium-ion batteries (SIBs) are considered very promising candidates for small-scale stationary storage of energy due to the high abundance and low-cost of sodium, especially for applications in which neither the weight nor the volume are the crucial criteria. Nevertheless, the continuous development and improvement of the electroactive materials are required to enable the real application of SIB technology. During the development of this PhD thesis, the layered $Na_xNi_{0.22}Co_{0.11}Mn_{0.66}O_2$ (NaNCM) was investigated as electroactive cathode material for SIBs. At first, NaNCM synthesis was optimized evaluating the impact of the synthesis parameters (annealing temperature and time and sample texture) on the material morphology and crystalline structure. Following, the electrochemical performance of NaNCM materials was investigated in a conventional organic carbonate (OC)-based electrolyte. The NaNCM synthesized under optimized conditions resulted in the best compromise among high capacity (140 mAh g^{-1}), high average potential (3.3 V vs. Na/Na^+) and stable long-term cycling. Looking to the safety aspect, the alternative ionic liquid (IL)-based electrolyte was explored, leading to extraordinary high capacities (220 mAh g^{-1}) and high long-term cycling stability. To summarize, the development of this thesis work resulted in a relevant contribution towards safer and high electrochemical performance SIBs.