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Stabilizing Na0.7MnO2 cathode for Na-ion battery via surface coating

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As sodium is abundant and inexpensive compared to lithium, Na-ion battery (NIB) has recently regained interest within the scientific community as a promising alternative to Li-ion battery for large-scale energy storage applications [1]. One of the challenges for commercialization of NIB is to develop cathode materials with high capacity and good stability. Among various NIB cathode materials reported to date, P2-type layered manganese oxide Na0.7MnO2 (NMO) has received much attention because of its high capacity (~200 mAh g−1), superior rate performance and ease of synthesis [2]. In addition Mn is low-cost, earth-abundant and environmentally friendly element. However, rapid capacity decay upon repeated cycles restricts its practical application. This effect is consequence of Mn is Jan-Teller cation which provokes crystal structure distortion and instability. It was demonstrated that coating P2-Na0.7MnO2 with a P2-Na0.7Ni0.33Mn0.67O2 (NNMO) enhances its cycle stability due to doping process and stabilizing the hexagonal phase of the material.
In our work, we have synthesized a series of NMO and NNMO cathode materials. The samples were obtained by sintering from precursor powders at a temperature of 900℃ in a stationary or in a flowing air atmosphere. By means of X-ray diffraction analysis it was shown that the material resulting composition strongly depends on the annealing conditions. Only during the synthesis in a stationary atmosphere, single-phase samples of mixed sodium-nickel-manganese oxide were obtained. At the same time, the structural disordering observed in the NMO material disappeared after the NMO coating with an admixture of sodium-nickel oxide. The synthesized materials were tested as part of model electrochemical cells.
In the future, we hope to conduct research on the doping of NMO with iron, since it is a more common and safe element than nickel.
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