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Development and Characterization of Cathode Materials for Sodium-Metal Chloride Batteries

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Abstract : Solid metal halides are used as active cathode ingredients in the case of Na-NiCl2 batteries that require a fused secondary electrolyte, sodium tetrachloraluminate (NaAlCl4), to facilitate the movement of the Na+ ion into the cathode. The sodium-nickel chloride (Na - NiCl2) battery has been extensively investigated as a promising system for large-scale energy storage applications. The growth of Ni and NaCl particles in the cathodes is one of the most important factors that degrade the performance of the Na-NiCl2 battery. The larger the particles of active ingredients contained in the cathode, the smaller the active surface available for the electrochemical reaction. Therefore, the growth of Ni and NaCl particles can lead to an increase in cell polarization resulting from the reduced active area. A higher current density, a higher state of charge (SOC) at the end of the charge (EOC) and a lower Ni / NaCl ratio are the main parameters that result in the rapid growth of Ni particles. In light of these problems, cathode and chemistry Nano-materials with recognized and well-documented electrochemical functions have been studied and manufactured to simultaneously improve battery performance and develop less expensive and more performing, sustainable and environmentally friendly materials. Starting from the well-known cathodic material (Na-NiCl2), the new electrolytic materials have been prepared on the replacement of nickel with iron (10-90%substitution of Nichel with Iron), to obtain a new material with potential advantages compared to current battery technologies; for example,, (1) lower cost of cathode material compared to state of the art as well as (2) choices of cheaper materials (stainless steels could be used for cell components, including cathode current collectors and cell housings). The study on the particle size of the cathode and the physicochemical characterization of the cathode was carried out in the test cell using, where possible, the GITT method (galvanostatic technique of intermittent titration). Furthermore, the impact of temperature on the different cathode compositions of the positive electrode was studied. Especially the optimum operating temperature is an important parameter of the active material.

Keywords : critical raw materials, energy storage, sodium metal halide, battery
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