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POS-20 Structural, Electrochemical and Thermal Properties of Nickel-rich LiNixMnyCozO2 Materials

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Nickle-rich LiNixMnyCozO2 (x + y +z = 1) (NMC) (Ni content higher than 60% of the total transition metals) is one of the most promising positive electrode materials for lithium-ion cells due to its high specific capacity of up to 220 mAh/g. Conventional NMC materials such as LiNi0.4Mn0.4Co0.2O2, LiNi0.5Mn0.3Co0.2O2, LiNi0.6Mn0.2Co0.2O2 etc. have more than 20% Co among the transition metal atoms. However, the high price of Co prevents the development of lithium ion batteries with low cost and high energy density for grid energy storage and electric vehicles. To lower the Co content while still maintaining good electrochemical performance, herein, the authors studied three series of materials with different transition metal ratios, which are LiNi0.6Mn(0.4-x)CoxO2 (x=0, 0.1, 0.2), LiNi(0.9-x)MnxCo0.1O2 (x=0.1, 0.2, 0.25) and LiNi0.8Mn(0.2-x)CoxO2 (x=0, 0.1, 0.2). The materials were synthesized via a co-precipitation-solid state sintering method [1, 2]. Powder X-ray diffraction and Rietveld refinement were carried out to investigate the structural properties of the materials. Coin-type cells were made to measure the electrochemical properties of the materials. In addition, accelerating rate calorimetry (ARC) was used to study the safety of charged NMC cathode materials in the presence of electrolyte. It was found that LiNi0.6Mn0.3Co0.1O2 and LiNi0.7Mn0.2Co0.1O2, which have 50% less Co content than current commercialized materials, exhibited excellent capacity and thermal stability, and therefore deserve careful consideration as next generation materials.
[1] van Bommel, Andrew, and J. R. Dahn. "Analysis of the growth mechanism of coprecipitated spherical and dense nickel, manganese, and cobalt-containing hydroxides in the presence of aqueous ammonia." Chemistry of Materials 21.8 (2009): 1500-1503.
[2] Li, Jing, et al. "Synthesis of Single Crystal LiNi0.5Mn0.3Co0.2O2 for Lithium Ion Batteries." Journal of The Electrochemical Society 16a4.14 (2017): A3529-A3537.

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