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The effect of nickel precursors on the electrochemical properties of spinel LiMn2−x Ni x O4 cathode: a comparative study of Ni(NO3)2centerdot6H2O and NiSO4centerdot6H2O as nickel sources

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Abstract

A comparative study was carried out with the effect of nickel precursors on the electrochemical performance of spinel LiMn2−x Ni x O4 (x = 0, 0.1 and 0.2) cathode materials. The spinel materials were prepared by employing a low temperature aqueous reduction synthesis route using locally sourced low-cost manganese precursor electrolytic manganese dioxide (EMD), and Ni(NO3)2centerdot6H2O as a nickel source. The EDS result has confirmed that the use of nickel nitrate provides more nickel content in the synthesized samples as compared to using nickel sulphate as a nickel source. Importantly, LiMn1.9Ni0.1O4 prepared with the nitrate salt showed the low impedance value (~294.7 Ω) than that of the nickel sulphate used spinel (~431.8 Ω), inferring that the nitrate salt generates low resistance in the spinel. The improved conductivity was observed with the small amount of nickel in both precursor used spinel, nickel salt used spinel showed high electrical conductivity (225.4 Ω) than the sulphate salt (330.7 Ω). A small amount of nickel addition showed the significant enhancement in capacity retention of LiMn1.9Ni0.1O4 and LiMn1.8Ni0.2O4 by retaining 88% and 145% of its initial capacity for nickel salt used spinel and the sulphate salt used spinel showed 83% and 92% of its initial capacity, respectively whereas the pristine LiMn2O4 showed only 56% of its initial capacity. The investigation clearly indicates that the substitution of small amounts of nickel into the spinel, irrespective of the precursor used effectively reduces the Jahn-Teller effects in the LiMn2O4.