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Synthesis of microstructural architectured NMC core/shell cathode powder

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NMC ($LiNi_xMn_yCo_zO_2$) cathode materials with a nickel content exceeding 80%, exhibit a remarkable discharge capacity of 200 mAh/g at 4.3 V [1]. However, increasing Ni content can involve rapid capacity fading, short cycle life, and poor thermal/structural stability. These drawbacks stem from the increased reactivity of Ni with surface oxygen during charge-discharge cycles, as well as larger Li/Ni cationic mixing, which can deteriorate the electrochemical performance. In order to overcome these issues, different approaches to develop NMC materials with controlled core/shell structured morphology have been proposed [2]. For instance, high Ni content ensures high specific capacity, while Mn-rich shell provides the improved structural and thermal stability. In this work, NMC core/shell particles have been synthesized via easy process-controlled oxalate-assisted co-precipitation method. To achieve the formation of core and shell with different compositions two-staged synthesis approach has been employed. To prevent interdiffusion between the core and shell, a thin WO_3 layer has been applied to the surface of the Ni-rich core particles. SEM, EDX, XRD techniques has been used to study the compositional, morphological and structural relations within core/shell particles. It has been shown that the formation of the R3m structure can be achieved for both NMC90 and NMC622 compositions at 850 °C. In-situ Li-infiltration approach results in the formation of NMC structures with a relatively high I(003)/I(104) ratio. Additional Li introduction via mechanical mixing leads to even higher I(003)/I(104) value, however in turn, causes the Li_2CO_3 formation.

[1] 10.1016/j.jpowsour.2013.01.063
[2] 10.1016/j.jpowsour.2019.227395