Stablilty of $LiCu_{0.25}Ni_{0.25}Mn_{1.5}O_4$ Cathode Compound Synthesized by a Sol-gel Process Investigated by In-situ X-ray Diffraction Analysis

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There has been great interests in developing lithium ion batteries with high energy/power density, high safety, long cycle life for applications electric vehicles (EV). The spinel oxides $LiNi_{0.5}Mn_{1.5}O_4$ as cathode material has been reported by several researchers that shows remarkable properties such as high voltage plateau and high energy density. However it still can't achieve pratical applications due to its low rate capability.The co-doped Ni-Mn spinel material been proposed to improve the cycling performance and rate capability further.

In this work, the structural transformation of Cu doped $LiCu_{0.25}Ni_{0.25}Mn_{1.5}O_4$ during charing process has been studied.The cathode material is prepared by a sol-gel process and cell is tested in the potential from OCP (3.01V) ~ to 5.0 V at 0.1C as Fig.1 shows. The capacity is up to 111 mAh/g.

From the ionic radius data, Cu^{2+} and L^{+} have similar radius when they exist in tetrahedral site or octahedral site. It means that Cu^{2+} and Li^{+} may exist in tetrahedral site (8a) or octahedral site (16d) randomly. They don't have preferred position Fig. 2 shows the In-situ XRD patterns of $LiCu_{0.25}Ni_{0.25}Mn_{1.5}O_4$. The wavelength is 0.619926 Å. The peak positions are gradually shifted to higher angles with the extraction of Li ions indicating a contraction of the lattice and There is no any peak splitting which indicating that no two-phase coexist. The structural properties suggest that the $LiCu_{0.25}Ni_{0.25}Mn_{1.5}O_4$ cathode compound is a high stability electrode candidate for advanced lithium-ion batteries.

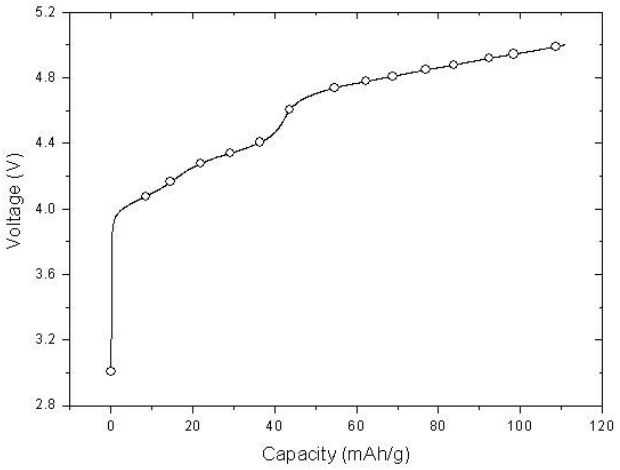

Fig. 1: Charge curve of $LiCu_{0.25}Ni_{0.25}Mn_{1.5}O_4$ from 3.0V to 5.0V at 0.1C.

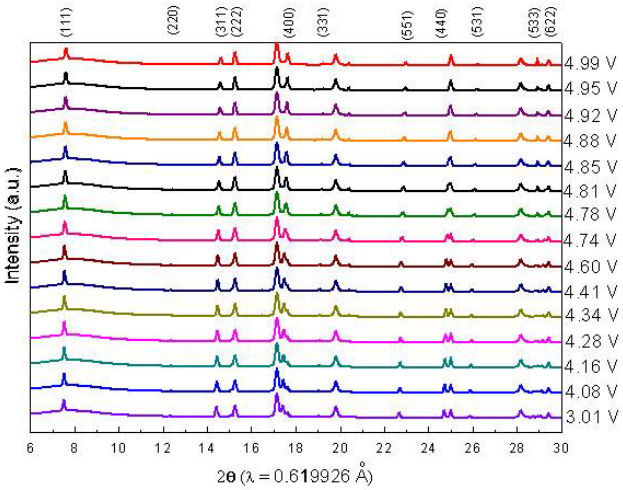

Fig. 2: In-situ XRD patterns of $LiCu_{0.25}Ni_{0.25}Mn_{1.5}O_4$ as charging process from 3.0V to 5.0V at 0.1C.