Preparation and Electrochemical characteristics of $Li[Ni_{0.5}Mn_{0.5}]O_2$ using NaOH coprecipitation.

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Introduction

The commercially Lithium ion batteries make use of layered $LiCoO_2$ cathode, but the high cost, toxicity is motivating low cost, non-toxicity cathode material. In this regard the layered $Li[Ni_{0.5}Mn_{0.5}]O_2$ has been attractive candidate for lithium ion battery and many researchers have reported electrochemical property and synthesis using manganese-nickel hydroxide [1-2].

Metal hydroxide for using NaOH coprecipitation have been applied in the alkaline rechargeable batteries and Li-ion batteries and used in points of low cost [3-4]. In this work, we have been researched manganese-based metal hydroxide precipitation in electrochemical properties, morphology and high-tap density for lithium ion battery.

Experimental

Manganese-nickel double hydroxide was prepared by feeding an aqueous solution of nickel and manganese sulfate, an aqueous solution of sodium hydroxide and an additive into a reactor under stirring in nitrogen atmosphere. The concentration, feed rate, temperature and pH of the mixture were all controlled. $(Ni_{0.5}Mn_{0.5})(OH)_2$ was extracted continuously from the reactor, then washed and dried at 110℃ without grinding. Nickel-manganese hydroxide had an average size of 10㎛.

$Li[Ni_{0.5}Mn_{0.5}]O_2$ was prepared by using appropriate amounts of $LiOH{\cdot}H_2O$ and manganese-nickel hydroxide. the mixed powder was preheated at 480℃ for 10hr, calcined at 1000℃ for 15hr and cooled slowly(2℃/min). Powder X-ray diffraction (Rigaku, Rint-2000) using CuKα radiation was used to identify the crystalline phase of the as-prepared powders. Charge-discharge cycles were performed in CR2032 button type cells and used electrolyte was a 1:2 mixture of EC and DMC containing 1M $LiPF_6$ by volume

Result and discussion

$Li[Ni_{0.5}Mn_{0.5}]O_2$ has the α-$NaFeO_2$ structure with space group $R\bar{3}m$, which is characteristic of the layered $LiCoO_2$ and $LiNiO_2$ structures. The lattice constants, *a* and *c* of $Li[Ni_{0.5}Mn_{0.5}]O_2$ calculated by rietveld refinement from the X-ray diffraction data is a = 2.8885Å, c = 14.2882Å, and c/a ratio is 4.947 in Fig 1. The $Li[Ni_{0.5}Mn_{0.5}]O_2$ electrode delivers a discharge capacity of 153 mA h g-1 between 2.8 and 4.3 V at current density of 0.2 mA cm^{-2} (20 mA g^{-1}) in Fig 2.

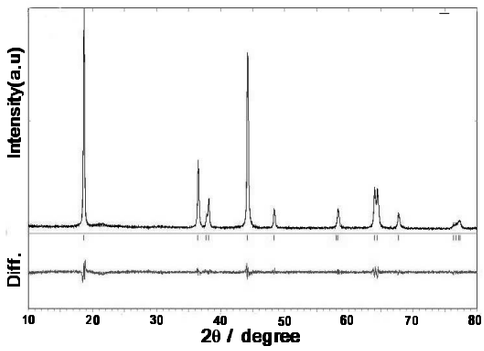

Fig 1. X-ray diffraction of the $Li/Li[Ni_{0.5}Mn_{0.5}]O_2$ powders and Rietveld refinement from the X-ray diffraction data

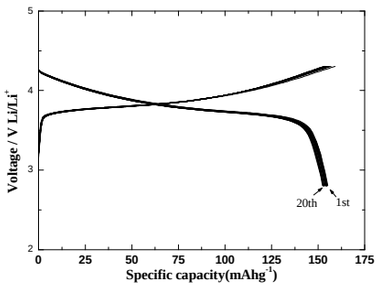

Fig 2. Charge-discharge curves of the $Li/Li[Ni_{0.5}Mn_{0.5}]O_2$ cell at a current density of 0.2 mA cm^{-2} at 30℃.

References

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