Abstract #1052, 224th ECS Meeting, © 2013 The Electrochemical Society

A High-Rate, Nanofiber $Li_{1.2}Ni_{0.17}Co_{0.17}Mn_{0.5}O_2$ / Carbon Cathode for Lithium-Ion Battery Applications

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The high cost, safety concerns, and limited rate capability of layered $LiCoO_2$ cathodes remain as constrains in developing lithium-ion battery technology for hybrid electric and plug-in hybrid electric vehicle applications. In this regard, structurally integrated $xLiMnO_3 \cdot (1-x)LiMO_2$ electrode materials, in which M is a promising cathode material for high energy lithium ion battery, because they could deliver a specific capacity over 200 mAh g^{-1} with an operating potential higher than 3.5 V (vs Li/Li^+) in average. [1,2]

However, Li-rich layered cathode materials are believed to have large irreversible capacity loss at first cycle, and inherently low conductivity. The poor electrochemical performance of $xLi_2MnO_3 \cdot (1-x)LiMO_2$ is due to the oxygen loss from the surface and insulating Li_2MnO_3 component, resulting in poor rate performance.[3,4] Much effort has been made to enhance the rate capability of such cathode materials. The preparation of nanostructure electrode has drawn increasing attention, as these cathode materials are normally adopted to solve the kinetic problems associated with solid-state diffusion of lithium ion intercalation and electronic conductivity.

In this paper, $Li_{1.2}Ni_{0.17}Co_{0.17}Mn_{0.5}O_2$ nanofibers were produced as cathode material for the first time by the combination of electrospinning and heat treatment. The physical, chemical and electrochemical properties of the $Li_{1.2}Ni_{0.17}Co_{0.17}Mn_{0.5}O_2$ nanofibers were investigated by X-ray diffraction, field emission-scanning electron microscopy (FE-SEM), high resolution transmission electron microscopy (HR-TEM), Brunauer, Emmett, and Teller (BET) measurements, and galvanostatic tests.

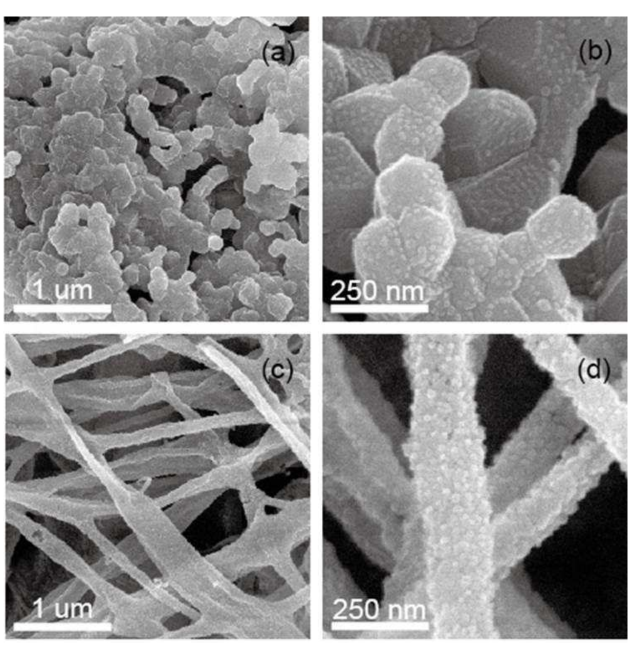

Fig. 1 SEM images of (a) and (b) $Li_{1.2}Ni_{0.17}Co_{0.17}Mn_{0.5}O_2$ particles, (c) and (d) $Li_{1.2}Ni_{0.17}Co_{0.17}Mn_{0.5}O_2$ nanofibers.

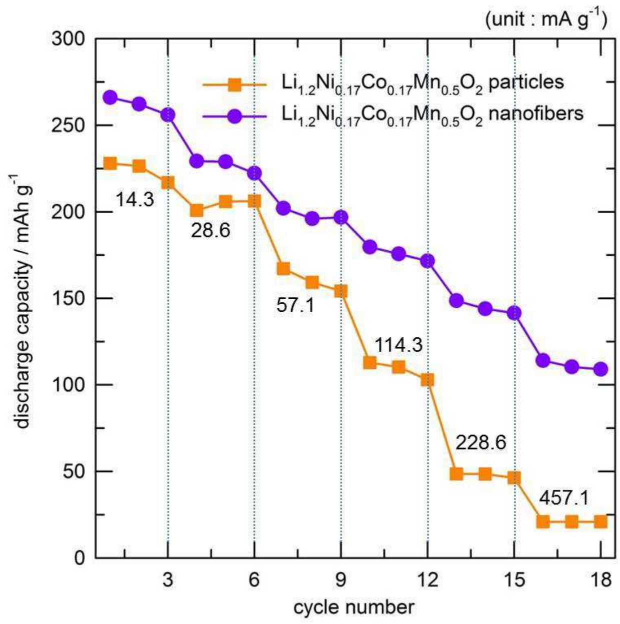

Fig. 2 Rate capabilities of $Li_{1.2}Ni_{0.17}Co_{0.17}Mn_{0.5}O_2$ particles and $Li_{1.2}Ni_{0.17}Co_{0.17}Mn_{0.5}O_2$ nanofibers cycled between 2.0 and 4.8 V. The cell was charged using a specific current of 14.3 mA g^{-1} before each discharge test.

References

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