It is clearly shown the material is composed of aggregated than the one obtained by the traditional process (Figure 1). A homogeneous size distribution is of higher crystallinity.

The oxidation-reduction process of Ni$^{2+}$/Ni$^{3+}$ around 4V$^\circ$ and a small platform existing near the 4.7 V. The platform around 4.7V is assigned to the oxidation-reduction process of Ni$^{2+}$/Ni$^{4+}$ while the 4.0 V platform of the corresponding material is attributed to the Mn$^{2+}$/Mn$^{4+}$ oxidation-reduction process.

Porous LiNi$_{0.5}$Mn$_{1.5}$O$_2$ has been thought one of most potential cathode material for high energy-density LIB. There are many methods reported to synthesize LiNi$_{0.5}$Mn$_{1.5}$O$_2$, such as ball-milling, sol-gel, co-precipitation and so on. But in these traditional synthesis methods, it is difficult to obtain a pure LiNi$_{0.5}$Mn$_{1.5}$O$_2$ with regular morphology, owing to the inhomogeneous distribution of nickel and manganese. In this present work, we reported a new process to synthesize a pure LiNi$_{0.5}$Mn$_{1.5}$O$_2$. The synthesized spherical LiNi$_{0.5}$Mn$_{1.5}$O$_2$ material with more homogeneous size distribution is of higher crystallinity than the one obtained by the traditional process (Figure 1).

The rate performance were carried out within the voltage range 3.5-4.9V under LAND CT-2001A instrument (Wuhan, China). The capacity of the synthetic materials was measured by the galvanostatic charge-discharge method at low rates and by a two-step charge process (constant current and constant voltage charge) at higher rates than 1C (including 1C) in the test. Figure 2 showed the discharge specific capacities of the porous spherical LiNi$_{0.5}$Mn$_{1.5}$O$_2$ were 120, 114, 116, 113, 108 and 101 mAh g$^{-1}$ at the rates of 0.2, 0.5, 1, 2, 5 and 10C respectively, suggesting good rate performance. Even after 50 cycles with successive charge-discharge rates variation, the discharge capacity of the material maintained at 122 mAh g$^{-1}$ at 0.2 C and the capacity retention was up to 98%. The good electrochemical performance can be considered due to the special stable structure of the LiNi$_{0.5}$Mn$_{1.5}$O$_2$ material, which provided enough inner space for the infiltration of the electrolyte and thus enlarged the electrode-electrolyte contact area and reduced Li$^+$ ion diffusion distance.

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Figure 1. Scanning electron microscopy (SEM) image of porous spherical LiNi$_{0.5}$Mn$_{1.5}$O$_2$ and a magnified inset of a single sphere surface.

Figure 2. The rate performance of the porous spherical LiNi$_{0.5}$Mn$_{1.5}$O$_2$. 

References