

SYNTHESIS AND ELECTRODE PROPERTIES OF LiFePO₄

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Introduction

Among the several materials under development for use as cathode in lithium ion batteries, the LiFePO₄ of the phospho-olivine family proposed by Goodenough^[1] and co-workers appears particularly interesting due to the low cost and the environmental compability of its basic constituents. Recently, many investigation^[2,3] have used ferrite (such as Fe(C₂O₄)₂) as the precursor to synthesis the LiFePO₄. However, owing to their poor conductivity Li⁺ can only be partially extracted/inserted at room temperature. F.croce^[4] and co-workers have proposed to improve the electrochemical kinetics of the LiFePO₄ electrode by a specifically designed preparation procedure that considered the dispersion of low particle size metal (copper) powders during the sol-gel formation of LiFePO₄ particles. In this paper we proposed to use the more inexpensive and easily gained material (Fe₂O₃) as the precursor to synthesis the LiFePO₄. In this paper, we also proposed another method not using the nitrogen to prevent iron (II) oxidation.

Experimental

The LiFePO₄/C composite was prepared by mixing Fe₂O₃, Li₂CO₃ and NH₄H₂PO₄, and 10% carbon. This precursor then put into crucible with carbon covered it and sintered in muffle at 650-750°C for 12h.

Electrochemical cells were assembled in dry atmosphere, utilizing 1M LiPF₆/EC-DEC as the electrolyte, a separator, a cathode composite with 85% sample, 10% carbon black, and 5% binder, and metal lithium as the counter electrode.

Results and discussion

Charging/discharging profiles of LiFePO₄/C at 0.2mA/cm² are showed in Fig.1. From Fig.1 we can see that there is a voltage flat around 3.4 V vs. Li, which in turn to is representative of an electrochemical process based on the coexistence of two structurally similar phases (LiFePO₄ / FePO₄). But there is another voltage flat around 2.5V, which maybe another materials is formed.

The cycling stability tests were performed at 0.2mA/cm² for 20 cycles in the Fig.2. From Fig.2 we can see that there is little loss of capacity after 20 cycles.

Fig.3 shows a cyclic voltammogram of LiFePO₄ at 0.1mV/s .The pair of peaks, consisting of an anodic and a cathode peak, observed around 3.4V vs. Li/Li⁺ corresponded to the two-phase charge-discharge reaction of the Fe²⁺/Fe³⁺ redox couple.

In conclusion, the LiFePO₄/C composite synthesized by this method successfully got most of the capacity and express excellent capacity stability.

References

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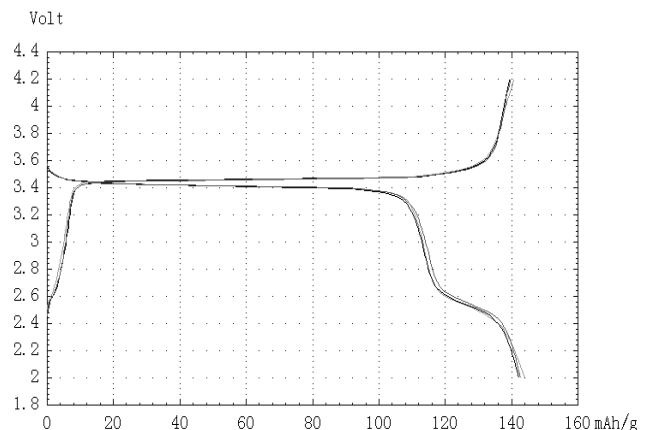


Fig.1 The charging/discharging profiles of the first three cycles of LiFePO₄ at 0.2 mA/cm² in the potential range from 2 to 4.2V

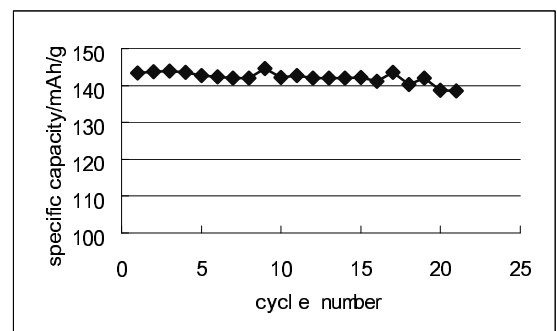


Fig.2. Electrical cycling tests of LiFePO₄ prepared at 700°C

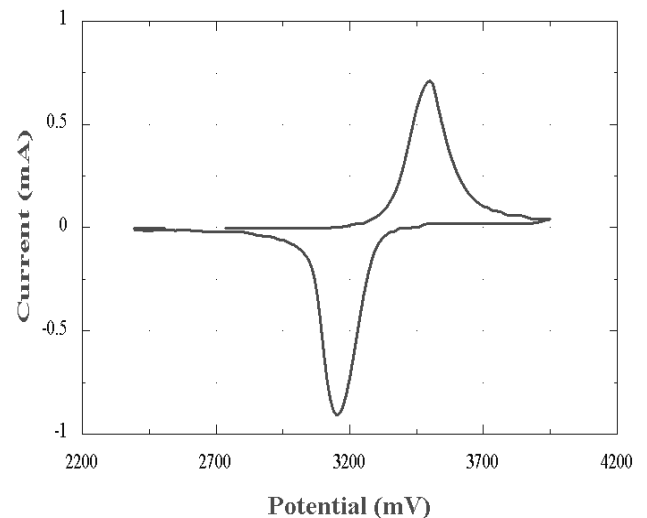


Fig.3 A cyclic voltammogram of LiFePO₄ at 0.1mV/s and at room temperature