Electrochemical Characteristics of $LiFePO_4$ with Conductivity Materials for Lithium Polymer Batteries

En Mei Jin[1], Jiao Wang[1], Xing Guan Zhao[1], Kyung-Hee Park[1], Hal-Bon Gu[1], Bok-Kee Park[2]
[1]Chonnam National Univ., [2]Howon National Univ.

Abstract : Phospho-olivine $LiFePO_4$ cathode materials were prepared by hydrothermal reaction. In this study, Multi-walled carbon nanotube (MWCNT) and Carbon black was added to enhance the electrical conductivity of $LiFePO_4$. $LiFePO_4$, $LiFePO_4$-MWCNT and $LiFePO_4$-C particles were characterized by X-ray diffraction (XRD), field emission scanning electron microscope (FE-SEM) transmission electron microscope (TEM). $LiFePO_4$/SPE/Li, $LiFePO_4$-MWCMT/ SPE/Li and $LiFePO_4$-C/SPE/Li cells were characterized electrochemically by charge/discharge experiments at a constant current density of 0.1mA cm^{-2} in a range between 2.5 and 4.3 V vs. Li/Li^+ and cyclic voltammetry (CV).

Key Words : $LiFePO_4$, Multi-walled carbon nanotube, Carbon black, SPE.

1. Introduction

Olivine-type structure $LiFePO_4$ is the most attractive because of its high stability, low cost, high compatibility with environment. However, it is difficult to attain its full capacity because its electronic conductivity is very low, and diffusion of Li^+ ion in the olivine structure is slow[1]. So, in this study, $LiFePO_4$ was prepared by hydrothermal reaction. In order to enhance the electrical conductivity of $LiFePO_4$, conductivit materilas as carbon black and MWCBT was added and their electrochemical properties were analyzed by means of charge/discharge experiments.

2. Experimental

$LiFePO_4$ was prepared by hydrothermal method at 150 ℃. Addition of ascorbic acid as a reducing agent to the precursor was useful in prohibiting the conversion of Fe^{2+} to Fe^{3+} during the hydrothermal reaction and generation of α-Fe_2O_3 during the annealing process. In order to improve low electron conduction of $LiFePO_4$, carbon black and MWCNT was added 5wt.%. A composite electrode was prepared by mixing $LiFePO_4$, $LiFePO_4$-C or $LiFePO_4$-MWCNT(5wt.%) and PVdF in a weight ratio of 70:25:5. The coin-type (CR2032) cells were fabricated for the electrochemical tests.

3. Results and discussion

Cycling performance of $LiFePO_4$/Li, $LiFePO_4$-C (5 wt.%)/SPE/Li and $LiFePO_4$-MWCNT (5wt.%)/SPE/Li cells are shown in Fig.1(a), Fig.1(b) and Fig.1(c), respectively. As can be seen from Fig.1, the discharge capacity of $LiFePO_4$/SPE/Li cell is 103 mAh/g at the first cycle and 86 mAh/g after 30 cycles, respectively. The initial and 30 cycles the discharge capacity of $LiFePO_4$-C (5wt.%) is 128 mAh/g and 126 mAh/g, respectively and the initial discharge capacity of $LiFePO_4$-MWCNT (5wt.%) is 124 mAh/g, and after 30 cycles the discharge capacity is 126 mAh/g, respectively. It is demonstrated that cycling performance of $LiFePO_4$-MWCNT (5wt.%)/SPE/Li cell is better and the cycling stability is good than that of $LiFePO_4$/SPE/Li and $LiFePO_4$-C/SPE/Li cell.

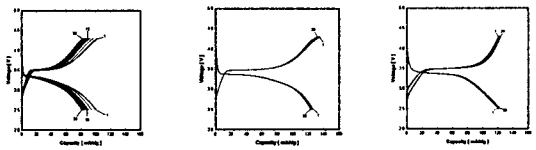

Fig.1. Cycling performance of (a) $LiFePO_4$/SPE/Li, (b) $LiFePO_4$-C/SPE/Li and (c)$LiFePO_4$-MWCNT/SPE/Li cell.

4. Conclusion

The discharge capacity of $LiFePO_4$/SPE/Li cell is 103 mAh/g at the first cycle and 86 mAh/g after 30 cycles, respectively. The discharge capacity of $LiFePO_4$-C/SPE/Li cell with 5 wt.% carbon black was 128 mAh/g at the first cycle and 126 mAh/g after 30 cycles, respectively. The discharge capacity of $LiFePO_4$-MWCNT/SPE/Li cell with 5 wt% MWCNT was 124 mAh/g at the first cycle and 126 mAh/g after 30 cycles, respectively. It was demonstrated that cycling performance of $LiFePO_4$-C (5 wt.%)/SPE/Li cells was better than that of $LiFePO_4$/SPE/Li cells and $LiFePO_4$-MWCNT (5 wt.%)/SPE/Li cell was better than that of another cells.

Acknowledgments

This research was financially supported by the Ministry of Education, Science Technology (MEST) and Korea Industrial Technology Foundation (KOTEF) through the Human Resource Training Project for Regional Innovation.

Reference

[1] H. B. Gu, B. Jin, D. K. Jun, and Z. J. Han, J. Nanosci. Nanotechnol. 7, 4037 (2007).