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Preparation of $LiMnPO_4$/ C Nanocomposites and Their Electrochemical Properties

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Introduction

Although $LiMnPO_4$ has been an attracted candidate for substitution of $LiCoO_2$, the very low electronic and ionic conductivities suppress its possibility to be a practical cathode material for Li-ion battery. In our previous study [1], the carbon coated $LiMnPO_4$ was successfully prepared by a combination of spray pyrolysis and dry ball-milling. In this study, we investigate the physical and electrochemical properties of $LiMnPO_4$/C nanocomposites prepared by a combination of spray pyrolysis (SP) with wet ball-milling (WBM).

Experimental

The experimental setup was described in our previous paper [2]. The precursor solution was prepared by dissolving $LiNO_3$, H_3PO_4, and $Mn(NO_3)_2.6H_2O$ in distilled water in stoichiometric ratio. The total concentration of precursor solution was 0.6 mol dm^{-3}. The feed solution was atomized at 1.7 MHz by an ultrasonic nebulizer and the generated droplets were carried into the reactor by N_2 + 3% H_2 gas. Reactor temperatures were varied from 200 to 500 °C. Then, the as-prepared powders were milled with 10 wt% of carbon by a planetary high-energy ball-milling at a rotating speed of 800 rpm, and then annealed at 500 °C in a N_2 + 3% H_2 atmosphere. Electrochemical measurements were carried out using coin-type cells (CR2032). Cycling performance of the cells was conducted galvanostatically at room temperature.

Results and Discussion

It is seen from the SEM images on **Fig. 1** that the primary particle size of the $LiMnPO_4$/C nanocomposites is in the range of about 50 to 150 nm for all of the samples. Among them, the sample synthesized at 300 °C has the highest specific surface area as shown in **Fig. 2**. Moreover, from the TEM image, $LiMnPO_4$/ C nanocomposites could be identified. **Fig. 3** shows the first charge/ discharge profiles of the $LiMnPO_4$/ C nanocomposite which was synthesized at 300 °C by SP. The cell delivered a first discharge capacity of 118 mAh g^{-1} at 0.05 C charge-discharge rate with a broad flat plateau around 4.1 V vs. Li/Li^+ and a small polarization loss.

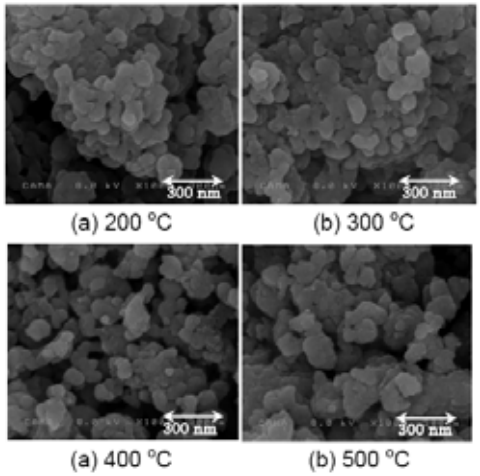

Fig. 1 SEM images of the $LiMnPO_4$/ C samples

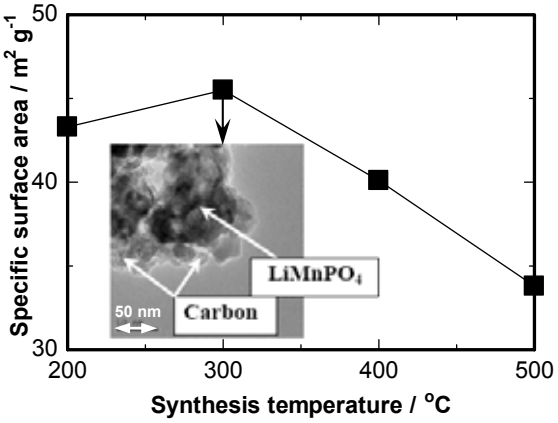

Fig. 2 Effect of synthesis temperature on the specific surface area of the $LiMnPO_4$/ C samples

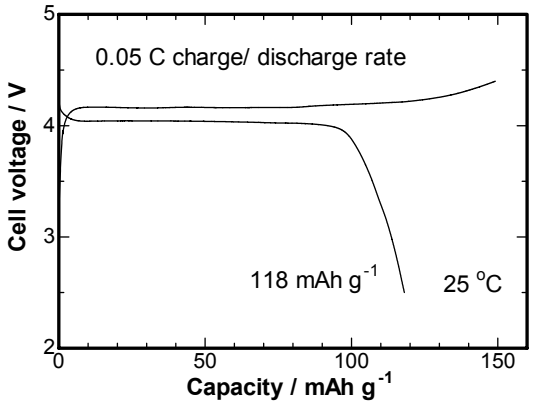

Fig. 3 First charge/discharge profiles of the $LiMnPO_4$/ C nanocomposite synthesized at 300°C by SP

Acknowledgement

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Literature cited

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