MICROWAVE ASSISTED METHOD OF SYNTHESIS OF LIFEPO$_4$/C COMPOSITE FOR LITHIUM-ION BATTERIES

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$LiFePO_4$ of olivine structure is widely applied as a cathode for modern lithium-ion batteries. The theoretical capacity of 170 $mAh \cdot g^{-1}$, high potential of charge/discharge (3.4 V vs Li/Li^+) and a long cycle life have been observed for this material. However, low electronic conductivity at the room temperature (10^{-9} $S \cdot cm^{-1}$) and small coefficient of diffusion ($1.8 \cdot 10^{-14}$ $cm^2 \cdot c^{-1}$) can be considered as disadvantages.

Increasing conductivity and electrochemical characteristics due to surface modification of $LiFePO_4$ by other conductive layers, first of all carbon coating, and decreasing the particle size by a microwave (MW) assisted method are employed in this communication. Li_2CO_3, $(NH_4)_2HPO_4$, $FeC_2O_4 \cdot 2H_2O$ and citric acid have been used for the synthesis of $LiFePO_4$/C composite. MW radiation power of 700 W has been set during the experiment.

Physico-chemical characteristics have been investigated by X-ray diffraction (CoK_α radiation) and electron scanning microscopy (JSM-6700F, JEOL, Japan) methods. Electrochemical characteristics have been obtained in model CR2016 coin cells on an automated electrochemical workstation using cyclic voltammetry (CV) and galvanostatic charge/discharge cycling methods in the range of potentials 2.0–4.2 V.

X-ray diffraction data for synthesized samples confirm the presence of the olivine structure and agree with literature data. SEM micrograph of the $LiFePO_4$/C composite sample is given in Fig. 1 and the observed average particle size is of about 100 nm. Dependences of capacity retention on current loads for $LiFePO_4$/C composite samples with a carbon content of 5 % obtained with and without MW radiation are presented in Fig. 2. It has been shown that the ability to sustain current loads of 1020 mA/g (6C) is better for $LiFePO_4$/C composite electrode synthesized by the MW assisted method. In another words, the capacity retention for this material is 50 % higher than that for the material obtained without MW treatment. The "microwave" sample can endure current loads up to 2550 mA/g (15C) without degradation as control cycles after power tests show (Fig. 3). This means that the "microwave" material can be prospective for high-power lithium-ion battery applications.

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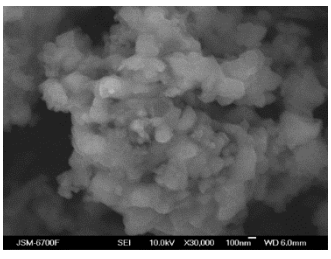

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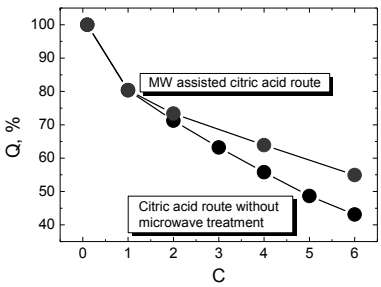

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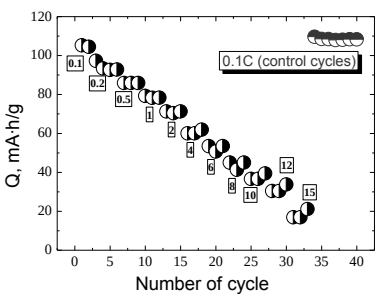

Fig. 1. SEM micrograph of the $LiFePO_4$/C composite sample
Fig. 2. Dependence of capacity retention on discharge current for $LiFePO_4$/C electrodes
Fig. 3. Charge/discharge characteristics of $LiFePO_4$/C synthesized by MW assisted method