Hydrothermal synthesis of $LiFePO_4$ micro and nanoparticles

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1. Introduction

Lithium iron phosphate ($LiFePO_4$) is one of the most competitive candidates for fabricating energy-driven cathode material for sustainable lithium ion battery (LIB) systems [1]. However, the performance of $LiFePO_4$ is limited by its poor electronic conductivity and by the inability of lithium ions to diffuse easily through the $LiFePO_4$/ $FePO_4$ interface, which can result in a significant loss of capacity high currents [2]. To improve its low diffusivity, several studies have focused on both the variation in particle size and morphology [3]. On the other hand, for the improvement of the electrical conductivity, other studies have focused on the coating of particles with carbon [4]. In this work the modification of the size and morphologies of the particles obtained by hydrothermal synthesis has been studied by means of the variation of the heating and cooling rates of the process.

2. Results and discussion

In this work, a temperature ranging from 300º to 400ºC was used, to promote the formation of pure $LiFePO_4$. The experiments were carried out with reaction times ranging from 5 min to 30 min.

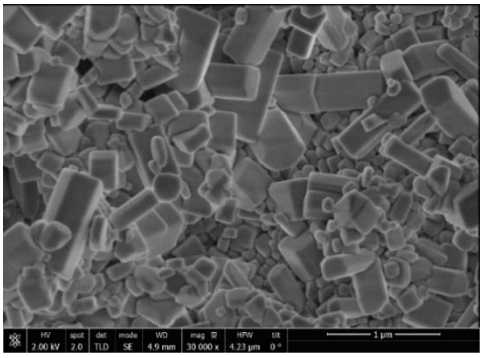

Figure 1: SEM micrographs image of $LiFePO_4$ obtained by hydrothermal synthesis

It has been observed that heating and cooling ratios are a key and fundamental factor for the process, and that reaction times longer than 30 min degrade the crystal structures of the particles obtained. Different types of morphologies were generated depending on the conditions (figure1): cubic-based, hexagonal and diamond-shaped particles. The effect of the operation conditions in the size, morphology and purity was also studied; pending further analysis to check their electrochemical functions. It has also been possible to prove that the use of supercritical water allows to obtained smaller, rounded shapes and better distributed particles, although the possibility to appear of iron oxides impurities increases.

3. Conclusions

The effect of the heating or cooling rates directly affect to the selectivity of the process and the size distribution. Hydrothermal synthesis makes possible the synthesis of micro and nano particles with excellent size, morphology and purity. The success in particle precipitation with these type of reactors opens a large field of study in future works, since these types of reactors allow very high rates of heating and cooling.

References

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