Synthesis of $LiFePO_4$ cathode material by microwave heating for lithium batteries

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Rechargeable lithium batteries are key components of the portable notebook computer and telecommunication equipment. The layer structure oxide $LiCoO_2$ is the earliest founded cathode material. Good performance and stability make it the main commercially used cathode material, despite toxicity and high material cost. Since the commercialization of $LiCoO_2$ by SONY in 1991, alternative cathode materials have been pursued to improve battery performance. Among the several cathode materials, $LiFePO_4$ of the phospho-olivine family proposed by Goodenough appears particularly interesting due to the low material cost and the environmental compatibility.[1]

For $LiFePO_4$, the discharge voltage is about 3.4V *vs.* lithium and capacity fade is very small even after several hundred cycles. Its theoretical capacity is 170mAh/g, which is as large as those of present cathode materials. On the other hand, one of the problems of this material is difficulty in synthesis of homogeneous ferrous compound.

In this work, we make $LiFePO_4$ powder with co-precipitation and simple microwave calcination process. Nano-particled $LiFePO_4$ is prepared using a co-precipitation method in water. H_3PO_4, $(NH_4)_2Fe(SO_4)_2$ and LiOH are mixed in water. A thick mixture of a deposit and a solution is obtained and then separated by centrifugal separator. The deposit is dried in vacuum oven and grinded to become a precursor. The olivine phase $LiFePO_4$ is synthesized by indirect heating using activated carbon in the domestic microwave oven(650W) without any reducing gas flow.

Figure 1 shows the XRD pattern of $LiFePO_4$ synthesized at microwave oven for 4 minutes and nano-sized particle distribution is shown in Figure 2. Therefore, microwave calcination is a useful alternative method to make $LiFePO_4$ powder without controlling the calcination atmosphere. Reducing atmosphere is produced easily by oxidation of the activated carbon during microwave irradiation. The advantages of microwave heating in this work are very short calcination time, simplicity, inexpensiveness.[3]

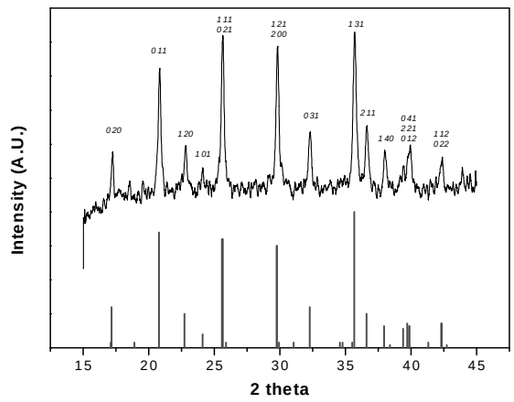

Fig. 1. XRD pattern of the microwave calcined $LiFePO_4$ powder and microwave irradiation time is only 4 minutes.

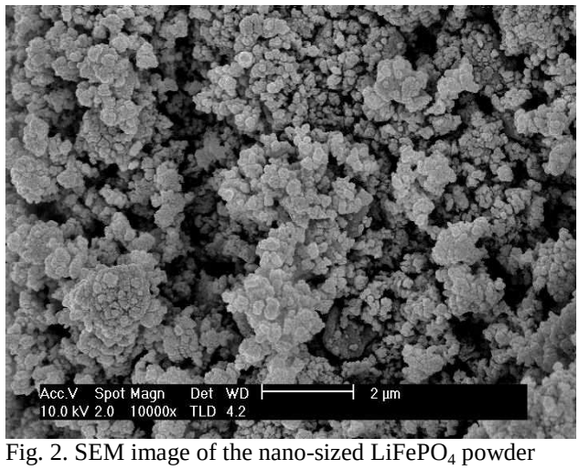

Fig. 2. SEM image of the nano-sized $LiFePO_4$ powder

References

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