Microwave-Assisted Solvothermal Synthesis of $LiFePO_4$ as Cathode Material of Lithium Ion Battery

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Among all the Li-ion battery (LIB) cathode materials, lithium iron phosphate (LFP) is found to have the highest thermal stability where oxygen atom is not released below 400 ^oC. Besides, the energy density and specific capacity are high enough to maintain a sufficiently long driving distance of EVs. However, the process of producing LFP is still a big concern, where the approach to inhibit the oxidation of Fe^{2+} to Fe^{3+} consume lots of energy and much reaction time is required. In recent years, microwave-assisted method has attracted the scientists' attention owing to its efficient heat transfer in which several minutes are sufficient to synthesize high crystalline LFP, and uniform heat transfer mechanism which enhances the homogeneity of the product. By selecting a proper solvent, the reaction temperature and pressure can be tuned. Thus, the microwave-assisted solvothermal synthesize of LFP is investigated in the present study. Ethylene Glycol (EG) was selected as the solvent based on literature report. By varying the time scale of reaction from 5 min to 25 min, it was found that 20 min (LFP-20) has the highest cycling stability where around 85% of capacity was retained after 500 cycles and promising specific capacity of around 136 mAhg-1 under 1 C. The encouraging result is mainly due to the small particle size obtained and higher structural stability upon cycling. With proper carbon content added to LFP-20, 5 wt%, the capacity retention has increased to around 94% after 1000 cycles. It also showed excellent rate capability in which specific capacity of 142, 141.3, 139.4, 137.5, 134.8, 125.9, 112.7 mAh g-1 under the rate of 0.1, 0.2, 0.5, 1, 2, 5 and 10 C respectively. Physical, chemical and electrochemical characterization of the materials were carried out to explain the obtained results.

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