Preparation of High Tap Density LiFePO₄/C through Carbothermal Reduction Process Using Beta-Cyclodextrin as Carbon Source

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As an economical and practical manufacturing process, the carbothermal reduction method is widely used for industrial production of LiFePO₄. In this work, an LiFePO₄/C cathode material with a high tap density of 1.3 g cm⁻³ was successfully synthesized through a novel carbothermal reduction process, which used FePO₄ as the precursor and beta-cyclodextrin as the carbon source. The prepared samples were characterized by X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), transmission electron microscopy (TEM) and Raman spectra. Their electrochemical performance was investigated with a galvanostatic charge/discharge system, cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The SEM and TEM results indicate that LiFePO₄/C microspheres with diameters of 5-10 μm aggregated by enormous nanoplates, and they were evenly coated with an amorphous carbon layer approximately 3 nm thick. The electrochemical results show that carbon coating could greatly optimize the electrochemical performance of LiFePO₄ owing to the improved electronic conductivity of the sample. Specifically, LiFePO₄/C exhibited not only a discharge capacity of 144 mAh g⁻¹ in the initial cycle at 0.1C (1C=170 mAh g⁻¹), but also a superior rate capability and excellent cycling performance.

Keywords: LiFePO₄/C; beta-cyclodextrin; carbothermal method; electrochemical performances

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