Carbon Coated Nano-Crystalline $LiFePO_4$ as Electrodes for Lithium Ion Batteries

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Lithium iron phosphate, $LiFePO_4$, is the most promising cathode materials for high-power lithium-ion batteries with potential application in hybrid electric vehicles. Nowadays the research efforts are mainly devoted to the improvement of the rate capability of $LiFePO_4$ electrodes by engineering of nanosized phosphates, by coating with carbon and by doping with alien cations.

The purpose of this contribution is to examine the electrochemical performance of carbon-coated nanocrystalline $LiFePO_4$ prepared by a new phosphate-formate precursor method. This method is based on the thermal decomposition of homogeneous phosphate-formate precursors. Structural and morphological characterization of $LiFePO_4$ is carried out by powder XRD, BET measurements, SEM and XPS analyses. The electrochemical behaviour is tested in model lithium cells using galvanostatic mode. By changing the solution concentration, the freeze-drying method allows preparing $LiFePO_4$ with mean particle sizes between 60 and 100 nm and different particle size distributions. The content of carbon (appearing mainly on the particle surface) depends on both the solution concentration and the annealing temperature. The effect of particle size distribution on the voltage profile of $LiFePO_4$ is also demonstrated. The specific capacity is mainly determined by the quantity of carbon deposited on the particle surfaces. The higher capacity and the best capacity retention are observed for $LiFePO_4$ obtained from a diluted solution and annealed at 500 ^oC. This sample is characterized by lower particle dimensions (about 85 nm), a narrow particle distribution (about 40 nm) and a carbon content of about 2.3 mass %.

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