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Effect of Glycine-to-nitrate Ratio on Solution Combustion Synthesis of $ZnFe_2O_4$ as Anode Materials for Lithium Ion Batteries

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Porous $ZnFe_2O_4$ nanoparticles have been successfully prepared via solution combustion synthesis, where glycine is used as a fuel and complexant in the combustion reaction. The effects of different glycine-to-nitrate ratio (where ratio equals 0.5, 1.0 and 1.5) on the combustion processes, phase composition, morphology and electrochemical performances of $ZnFe_2O_4$ are investigated in detail. As the glycine content changing, we can find a regular variation in the exothermic reaction temperature, porous structure and crystallinity. Among three samples, the ratio 1.0 sample reveals the highest crystallinity without any impurity and exhibits a higher rate capability and better reversibility as well. At current density of 1600 mA g^{-1}, its average discharge capacity is 882.1 mAh g^{-1}. When the current density returns to 100 mA g^{-1}, the average discharge capacity recovers to 1232.5 mAh g^{-1}. After 100 cycles at 200 mA g^{-1}, the discharge capacity of ratio 1.0 sample is 1195.3 mAh g^{-1}, which is even higher than the second cycle. The superior electrochemical performances can be attributed to the uniform porous structure in pure phase, which can not only ease the volume expansion during the charge-discharge processes but also provide more interstices for lithium ions insertion. Futhermore, the high crystallinity is able to stabilize the microstructure with no collapse after numerous repeated lithiation-delithiation processes.

Keywords: Solution combustion method, $ZnFe_2O_4$, Glycine-to-nitrate ratio, Electrochemical performance, Lithium ion batteries.

FULL TEXT