Enhancement of Cycling Stability of LiMnPO₄ at Elevated Temperature by Fe-Mg co-Substitution

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Olivine-type LiMnPO₄ has been extensively investigated as a promising cathode material for the next-generation high performance Li-ion batteries due to its high working voltage (4.1 V vs Li⁺/Li) and high theoretical specific capacity (170 mAh g⁻¹). However, poor cycling performance at elevated temperature hinders its practical application. Here carbon coating and Fe-Mg co-substitution of LiMnPO₄ is attempted by a facile solid-state process. To substitute the smaller Fe²⁺ ions and Mg²⁺ ions for the larger Mn²⁺ ions strengthens the Mn-O bond, which makes the structure of LiMnPO₄ more stable. Hence, Mn dissolution in the electrolyte is retrained. The obtained LiMn_{0.9}Fe_{0.09}Mg_{0.01}PO₄/C material presents a high discharge capacity (160 mAh g⁻¹ at 0.1 C) and excellent cycling performance at elevated temperature. Even at a high rate of 1 C, it delivers a capacity of about 135 mAh g⁻¹ at 50 °C without capacity fade after 120 cycles.

Keywords: Lithium-ion batteries; Lithium Manganese Phosphate; Mn dissolution; elevated temperature; co-substitution

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