LATP ionic conductor and in-situ graphene hybrid-layer coating on $LiFePO_4$ cathode material at different temperatures

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ABSTRACT

In this work, a hybrid-layer coated $LiFePO_4$/C (LFP/C) cathode material is investigated for the application of high temperature performance of Li-ion battery. The electrochemical performance of the material is significantly enhanced by improving its ionic and electronic conductivity via hybrid-layer coating, i.e., $Li_{1.4}Al_{0.4}Ti_{1.6}(PO_4)_3$ (LATP) and graphenenanosheets (GNS) layer. Initially, the LATP layer is coated by a sol-gel method and later, the in-situ GNS layer is coated through a wet chemical process. The characteristic properties of LFP/C@LATP@GNS composite are examined by various spectroscopy and microscopy method. The electrochemical performances of LFP/C@LATP@GNS cathode material have been evaluated at different temperature such as −20 °C, 25 °C and 55 °C. The best electrochemical performance is observed at 55 °C with the discharge capacities of 160, 156, 154, 153, 149, 144, and 130 mAh g^{-1} at 0.1C, 0.2C, 0.5C, 1C, 3C, 5C, and 10C rate, respectively. Due to its higher ionic and electronic conductivity, the long cycle-life is obtained for LFP/C@LATP@GNS cathode material at 55 °C, which is maintained over 500 cycles at 10C rate with the fading rate of ca. 8.76%. Hence, the dual-layer coating on LFP cathode material is the superior method to develop the high performance Li-ion battery for electric vehicles.

KEYWORDS:

$Li_{1.4}Al_{0.4}Ti_{1.6}(PO_4)_3$ (LATP); In-situ grapheme; Hybrid coating; Surface modification; $LiFePO_4$