Effect of N-N Dimethyltrifluoroacetamide Additive on Low Temperature Performance of Graphite Anode

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The effects of N-N Dimethyltrifluoroacetamide (DTA) on the low temperature performance of Li-ion batteries were evaluated, electrolyte ionic conductivity test, charge-discharge, cyclic voltammetry (CV), scanning electron microscope (SEM), X-ray photoelectron spectroscopy (XPS) and electrochemical impedance spectroscopy (EIS) were used to analyze the electrochemical processes. The results showed that the first charge capacities of the graphite electrode in the electrolyte without and with DTA were 72.2 and 114.6 mAh g⁻¹ at -20°C, 325.1 and 370.8 mAh g⁻¹ at 20°C, respectively. After 100 cycles, the corresponding capacities fade to 64.5 and 108.72 mAh g⁻¹ at -20°C, 299.5 and 348.5 mAh g⁻¹ at 20°C, and the capacity retention were 88.7% and 94.8% at -20°C, 92.12% and 93.9% at 20°C, respectively. The first Coulomb efficiency in the electrolyte with and without DTA was 87.41% and 83.37% at 20°C, respectively. The electrolyte ionic conductivity test shows DTA increases the ionic conductivity of 1mol/L LiPF₆ 2:1:4 (vol.%) EC/DEC/EMC. The SEM and XPS showed that DTA additive make the SEI film become more dense and uniform and reduce the content of the unstable substance alkyl lithium carbonate and increase the content of LiF in the SEI film at -20°C. EIS results demonstrated that the SEI resistance of the Li/graphite batteries with DTA was far smaller than those without DTA, especially at -20°C. The improved electrochemical performance with DTA was attributed to the enhancement of the conductivity of the electrolyte, the decrease of the SEI resistance.

Keywords: Lithium-ion batteries; low temperature; N-N Dimethyl Trifluoroacetamide additive; Solid electrolyte interface (SEI) film

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