Enhanced Performance of $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ Cathodes at Elevated Temperatures Using an Imidazolium-Based Electrolyte with Lithium Difluoro(oxalate)Borate

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Novel electrolytes containing 1,2-dimethyl-3-ethylimidazolium bis(trifluoromethylsulfonyl)imide, an ionic liquid (DMEITFSI); carbonate solvents; and lithium difluoro(oxalate)borate (LiDFOB) were prepared, and the electrochemical performance in $\text{Li}/\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ half cells was investigated. The ionic liquid electrolytes exhibited excellent physical and electrochemical properties, including high thermal stability, incombustibility and a wide electrochemical window. The addition of LiDFOB significantly improved the compatibility of the ionic liquid with $\text{Li}/\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$, which presented a discharge capacity of 138.5 mAh g^{-1} after 100 cycles at 1.0 C. Among the tested electrolytes, $\text{Li}/\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ cells showed the best performance at high temperatures, delivering superior discharge capacities of 157.7 mAh g^{-1} after 50 cycles at a rate of 1.0 C and a temperature of 80 °C. The decomposition of LiDFOB resulted in the formation of a stable and protective film on the surface of the $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$ cathode. Therefore, nonflammable DMEITFSI-based electrolytes are an excellent alternative for lithium-ion batteries at room and elevated temperatures.

Keywords: Hybrid electrolyte, Ionic liquid, Safe electrolyte, High temperature, Lithium difluoro(oxalate)borate.

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