Safe Hybrid Electrolytes Based on Ionic Liquid and Carbonate Solvents for High-Temperature Li-rich Lithium-Ion Battery

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This work focuses attention on investigating N-butyl-N-methylpiperidinium bis(trifluoromethylsulfonyl) imide (PiP₁₄TFSI)/carbonate-based electrolytes. The main goal is to substitute a conventional LiPF₆/carbonate electrolyte for Li-rich/Li cells operating under both high voltage and high temperature. The safe electrolytes exhibit excellent physical and electrochemical properties at temperatures higher than 55°C. The Li-rich/Li cells with ionic liquid (IL)/fluoroethylene carbonate (FEC)-based electrolyte obtained 163.1 and 180.3 mA h g⁻¹ at 0.5 C at 55°C and 1 C at 70°C after 100 cycles, respectively. The Li-rich/Li cell with IL/FEC-based electrolyte also achieved brilliant cyclic performance at 85°C, which is considered an extreme temperature. The remarkable cyclic performance at high temperature is ascribed to a dense and robust solid electrolyte interface (SEI) film originating from the IL/FEC-based electrolyte. According to the properties of the IL/FEC-based electrolyte, the proposed electrolyte material is promising for application to a high-temperature lithium-ion battery.

Keywords: High-temperature Li-rich cell; Safety; Ionic liquid; High voltage electrolytes; Solid-electrolyte interface

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