Enhancing the low-temperature characteristics of a Li/graphite half-cell by the comprehensive modification of electrolyte

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The behavior of electrolytes with decreasing temperature generally affects the overall performance of lithium-ion batteries. Freezing of the electrolyte, increased viscosity, reduced ionic conductivity, and increased charge transfer resistance are the main limitations stemming from the electrolyte side. In particular, batteries with commercial electrolyte and a well-known graphite anode are recognized as poorly operated at low temperatures due to a large loss of capacity (more than 50% of its room-temperature capacity) even at zero degrees. In this work, a complex modification of the lithium salt and solvents was applied simultaneously to develop an optimal electrolyte system with improved low-temperature characteristics for the Li/graphite half-cell. Various concentrations of commercial and alternative lithium salts, dissolved in a mixture of solvents, are used as electrolytes to determine the best interaction with a graphite electrode at low temperature. A solvent mixture of non-carbonate organic ester with low freezing point and SEI-forming fluorinated co-solvent in a ratio of 9:1 is used to prevent freezing of the electrolyte and ensure the formation of a more conductive SEI layer, respectively. The Li/graphite half-cell with the designed electrolyte system has retained about 90% of its room-temperature capacity at zero degrees, demonstrating a new perspective for the development of low temperature type electrolytes.

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