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The use of fluorinated electrolytes in lithium-ion batteries for improved safety in human-rated aerospace and terrestrial applications

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Throughout its development, safety has been a driving force in lithium-ion battery technology, from the transition away from lithium metal anodes to the vast array of electrolyte formulations which continue to be proposed.[1] Although the probability of catastrophic failure can be (and has been) mitigated by advances in internal cell protection devices, the development of advanced electrode materials with improved stability,[2] and the discovery of SEI-promoting agents[3] designed to minimize electrolyte decomposition and subsequent gas evolution or self-heating, the electrolytes currently in use remain in themselves highly flammable mixtures. Flame retardant additives (FRAs), present in small quantities, have been extensively investigated as a means to reduce this flammability.[4] Another approach, however, is to replace common solvents with ones which are inherently less flammable, but whose presence does not adversely impact capacity, cycle life, or SEI formation. Fluorinated organic compounds are generally more resistant to oxidation than their non-fluorinated analogues due to fluorine's high electronegativity.[5] In previous studies we have identified a number of fluorinated carbonates[6] and esters[7] which are attractive co-solvents for lithium-ion battery electrolytes. Herein we present a study of the effect of the use of several fluorinated solvents, including monofluoroethylene carbonate, bis(2,2,2-trifluoroethyl) carbonate, and 2,2,2-trifluoroethylmethyl carbonate on the performance of three-electrode, $LiNi_{0.8}Co_{0.2}O_2$/MCMB cells containing $LiPF_6$ and various FRAs.

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