

Effect of Phosphorous-based Fire-retardants in Electrolytes on Performance of Li-ion Cells

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Lithium ion (Li-ion) batteries have been widely used as power sources in portable devices such as cell phones, notebook computers, and camcorders since they were introduced in early nineteen nineties (1). However, the use of large size Li-ion batteries as electric power in combustion engine-electric power hybrid vehicles has not yet been adopted. Safety hazard of large size Li-ion batteries such as gassing, flame, and explosion under extreme conditions is one of the major concerns. The highly flammable electrolyte is one of the factors responsible for the safety hazard.

Incorporating fire retardant as an additive or a co-solvent was attempted to control the flammability of the electrolyte. Given the unexplored arena of non-flammable electrolytes, pioneer researchers turned to the traditional favorites of the fire-fighting industry: alkyl phosphates (2) or phosphazenes (3). Several reports on this topic have been published, however, detailed investigation on the impact of phosphorous-based additives/co-solvents on the performance of Li-ion cells is still lacking. For example, the crucial question about whether these new solvent components are stable with the carbonaceous anode remains unclear.

We will report our investigation on the above issues. We also report how the effectiveness of fire-retarding ability of some known fire-retardants correlates to the cell performance.

References:

- (1) S. Megahed and B. Scrosati, *Interface*, **3**, 34 (1994)
- (2) U. S. Patent **5,830,600**
- (3) C. W. Lee, R. Venkatachalapathy, J. Prakash, *Electrochem. and Solid State Letts.*, **3**, 63 (2000)

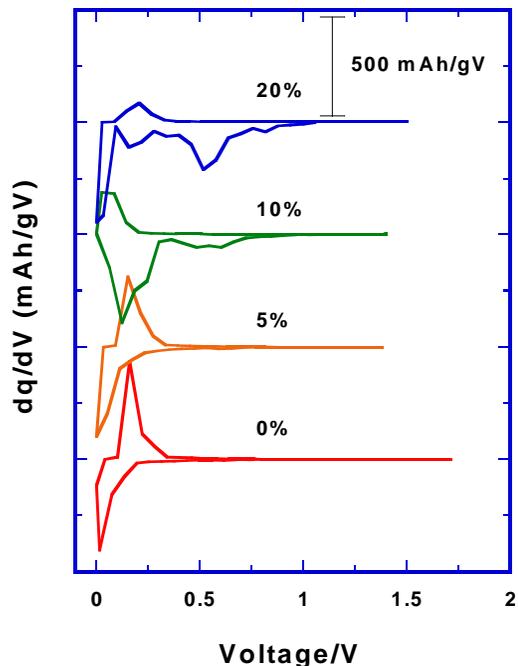


Fig. 1 Effect of trimethylphosphate content (weight percent) in electrolyte on Li intercalation into and de-intercalation out of carbonaceous anode.

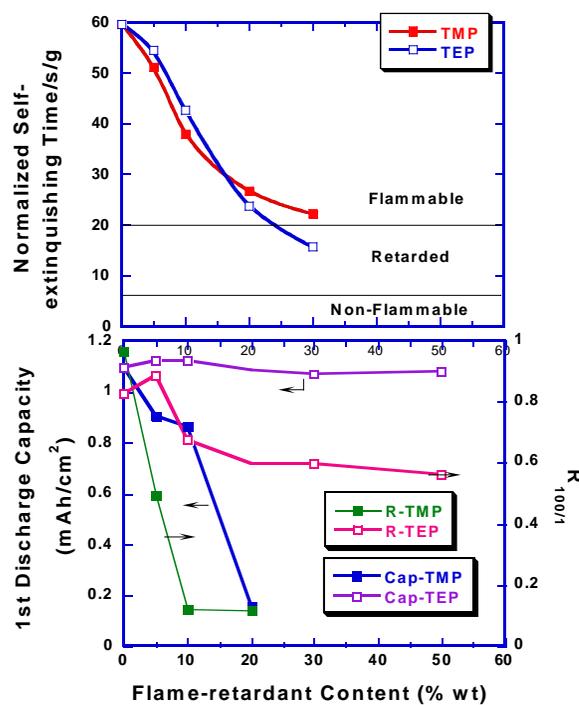


Fig. 2 Correlation between fire-retarding effectiveness and discharge capacity as a function of flame-retardant content.