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New Flame-retardant Additives for Lithium Batteries

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Improvement of safe design of lithium batteries (lithium battery and lithium polymer battery) have attracted much interest as means for safe operation of these batteries in HEV application. Therefore, we focused on finding out practical electrolyte additives which possess activities of both flame-retardance and heat resistance in conventional electrolyte cell systems, since thermal runaway behavior of these cells under abusive operating condition and the flammability of conventional electrolytes are roots of the stubborn drawback of lithium batteries.

With regard to resolution of above-mentioned issue, we extracted phosphorous nitrogen compounds, phosphazene, as flame-retardant additives. We tried to optimize the chemical structure in order to obtain the technology for eliminating risk of fire without hampering cell performance. As a result, partially fluorinated cyclo-phosphazene groups show novel flame-retardant activity.[1]

In this presentation, we would like to show the flame and heat resistance properties of phosphazene compounds in detail. The properties of our additives against fire and heat will be discussed by using data which could be obtained by flame, flash point and limited oxygen index tests and some calorimetry such as accelerating-rate calorimetry (ARC) and/or differential scanning calorimetry (DSC). As examples, Figure 1 and 2 show sequences of flame tests of the conventional electrolyte with and without phosphazene compound by using arranged UL-94HB test. It was clearly indicated that our flame-retardant additive have excellent ability for rendering the conventional electrolyte nonflammable.

Figure 1. Sequence of flame test of conventional electrolyte with flame retardant.

Figure 2. Sequence of flame test of conventional electrolyte without flame retardant.

1. Masashi Otsuki, Shigeki Endo and Takao Ogino, *International Battery Association-5th Hawaii Battery Conference*, p39(2004).