Advanced Low-flammable Electrolytes

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This paper deals with increasing the fire safety of lithium ion batteries. The safe storage or operating of batteries is a very actual theme which needs to be resolved especially with the advent of electric cars. The safe operation of batteries is critical in applications where it may endanger human health or even life. In recent years, incidents of ignition or explosion of lithium-ion batteries have been known, both in mobile phones and in aircraft storage. This work is focused on substitution of standard aprotic solvent (dimethyl carbonate) with new low flammable solvents such as sulfolane or dimethyl sulfone [1-3]. From the results it is obvious that sulfolane increase the flash point in average by 44% compared to the standard solvent combination. The flash point was measured by open cup method on SETAFLASH model 31000 -0 device.

The second main goal for increase the fire safety of batteries is to use flame retardants as an additive in electrolytes [4-6]. Phosphorus flame retardants were tested. The best results showed triethyl phosphate (TEP) which increased both flash point temperature and specific conductivity. The standard commercially used combination of solvents (ethylene carbonate and dimethyl carbonate) have the flash point at ambient temperature (due dimethyl carbonate). In combination ethylene carbonate, sulfolane and TEP the flash point increased to 167 °C. In this combination increase the flame retardant the specific conductivity by 41% compare to pristine electrolytes. The specific conductivity was measured by electrochemical impedance spectroscopy and immersion cell.

From the results is obvious, that use of flame retardant in aprotic electrolytes is a promising way to enhance the fire safety of lithium-ion batteries. Use of flame retardant allow also increase the operation temperature of batteries which in the end can increase the charging and discharging current and shorten charging time.

Acknowledgement:

This work was supported by project the Centre for Research and Utilization of Renewable Energy under project No. LO1210 – "Energy for Sustainable Development (EN-PUR)" and a grant of Czech Science Foundation (GA 17-00607S).

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