The effect of methyl acetate, ethylene sulfate, and carbonate blends on the parasitic heat flow of NMC532/graphite lithium ion pouch cells

Stephen L. Glazier,[a] Jing Li,[a] Xiaowei Ma,[a] Jennifer Allen,[b] J. R. Dahn[a]
[a] *Dept. of Physics and Atmospheric Science, Dalhousie University, Halifax NS, Canada, B3H1K5*
[b] *Dept. of Chemistry, Dalhousie University, Halifax NS, Canada, B3H1K5*

E-mail: *stephen.glazier@dal.ca*

The formulation of different solvent systems can have a severe impact on the lifetime, rate performance, and temperature performance of lithium ion cells. Methyl acetate (MA) has been found to increase rate and temperature performance of carbonate solvents, but leads to poor cell lifetime.[1,2]

This work used ultra-high precision coulometry, in-situ gas analysis, and isothermal microcalorimetry to investigate a promising high rate additive blend of fluoroethylene carbonate (FEC) and ethylene sulfate (DTD) in $LiNi_{0.5}Mn_{0.3}Co_{0.2}O_2$/graphite pouch cells. Solvent systems composed of blends of ethylene carbonate (EC), ethyl methyl carbonate (EMC), and dimethyl carbonate (DMC) were investigated, with additions of 0%, 20% and 40% wt. MA. MA was found to decrease the coulombic efficiency and increase slippage, parasitic heat flow, gas volume, and capacity fade. Figure 1 shows the parasitic heat flow of cells charged from 4.0 V to 4.3 V with different amounts of MA. The addition of just 1% wt. of DTD to 2% FEC was able to improve the performance of cells containing 20% and 40% MA to that of cells containing no MA and 20% MA, respectively, under 4.3 V. This trend was also found in UHPC results, as well as in-situ gas measurements during high voltage holds. This work highlights the importance of high precision in-situ studies when designing and optimizing new electrolyte systems for operation at high voltage, high rate, and low temperature.

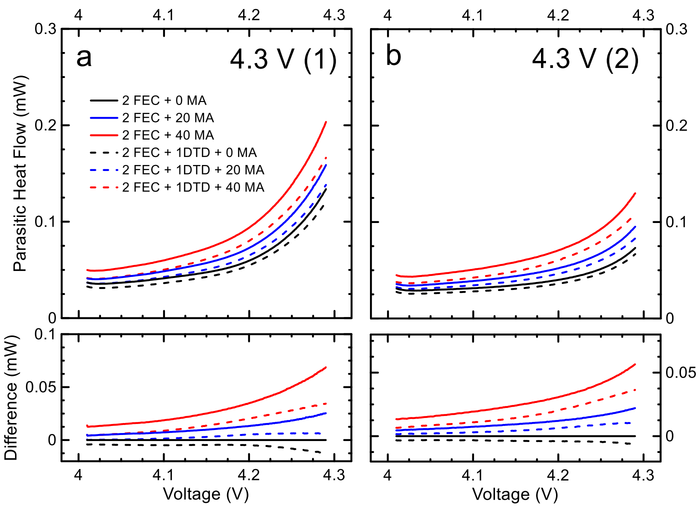

Figure 1: Parasitic heat flow of cells containing 0%, 20%, and 40% wt. MA with 2% wt. FEC and 2% FEC + 1% DTD during two cycles to 4.3 V.

References:

[1] Smart, M. C.; Ratnakumar, B. V.; Surampudi, S. Use of Organic Esters as Cosolvents in Electrolytes for Lithium-Ion Batteries with Improved Low Temperature Performance. *J. Electrochem. Soc.* 149 (2002) A361–A370.

[2] Sazhin, S. V.; Khimchenko, M. Y.; Tritenichenko, Y. N.; Lim, H. S. Performance of Li-Ion Cells with New Electrolytes Conceived for Low-Temperature Applications. *J. Power Sources* 87 (2002), 112–117.