INVESTIGATIONS OF THE EXOTHERMIC REACTIONS IN LI-ION CELLS

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The electrochemical and thermal characteristics of Li-ion cells strongly depends on the cell operating temperature. The effect of temperature on the lithium-ion cells performance is evident especially when the battery is operating at low temperature (<10°C). At such low temperatures a considerable loss of the cell capacity is observed mainly due to the decrease of ionic conductivity, electrochemical reaction rates, electrical conductivity, and solid lithium diffusion at low temperature (1,2). On the other hand, although a better performance is expected at higher temperature, most lithium-ion cell manufacturers recommend operation below 65°C to avoid thermal runaway and hence cell rupture (3). Due to the interdependence of temperature, performance, and safety, the thermal behavior of batteries is of paramount importance in selecting the electrode materials, operating conditions and extending the safety and life of the battery.

It has been well documented in the literature (4-6) that the exothermic reactions of electrodes with the electrolyte can cause the Li-ion cells to undergo thermal runaway at relatively low temperatures especially at increasing state of charge. Use of calorimetric methods such as differential scanning calorimetry (DSC) and accelerated rate calorimetry (ARC) can provide information regarding the thermal behavior of Li-ion cells.

We have studied the thermal behavior of Mag10-natural graphite anode and LiNi\textsubscript{0.8}Co\textsubscript{0.15}Al\textsubscript{0.05}O\textsubscript{2} cathode at various state-of-charge using DSC and ARC. Fig.1 shows the DSC behavior of the 100% charged LiNi\textsubscript{0.8}Co\textsubscript{0.15}Al\textsubscript{0.05}O\textsubscript{2} cathode at various heating rates. An increase in the heating rate increases the heat flow rate and shifts the onset of the exothermic peaks to higher temperature. Results of the thermal studies will be presented and discussed and discussed in detail.

References: