HQ $Li_4Ti_5O_{12}$/$LiFePO_4$ Power Battery For Fast Charge Applications

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Many challenging problem must be resolved for integration of safe Li-ion batteries for automotive transportation. The combination of lithium nano-titanate oxide ($Li_4Ti_5O_{12}$) anode and lithium iron phosphate ($LiFePO_4$) cathode is a leading candidate for this application. This combination of electrode materials provides a high degree of safety, long cycle life and rapid charge in 4 minutes.

The advantages of $Li_4Ti_5O_{12}$ are high stable structure without passivation, flat voltage profile of 1.5 V, high safety and low cost.

The electrochemical investigation was carried out using 18650 cell with standard organic electrolyte, and the cell demonstrated a remarkable cycle life (see Fig.1). A very stable discharge capacity was obtained at a 5C discharge rate (12 minutes) and 15C charge rate (4 minutes). The capacity remained almost constant at 850 mAh/g for approximately 30,000 cycles at 100% DOD [1].

Security tests was performed on the 18650 cell in the charged state after 30,000 cycles. The crush test (see Fig 2) showed a maximum temperature of 72°C. The nail penetration test revealed that the cell reached a maximum temperature of 103°C, with a small amount of electrolyte escaping from the cell. Finally, a short-circuit test showed a maximum temperature of 63°C. For all three tests no smoke, no flames and no explosion were observed.

Because of these significant and promising results, PHET (Taiwan) developed a unique system of protection for EV battery packs consisting of 18650 cells. The patented DOSBAS® safe battery system (see Fig. 3) will protect each cell in the system individually by serially connected quick-blown fuse [2].

[1] A. Guerfi, J. Power Sources., **195**, p.851 (2010).

[2] Peijen Wang and Donald P.H. Wu, presented at EVS24, Stavanger, Norway, May 13-16, 2009.

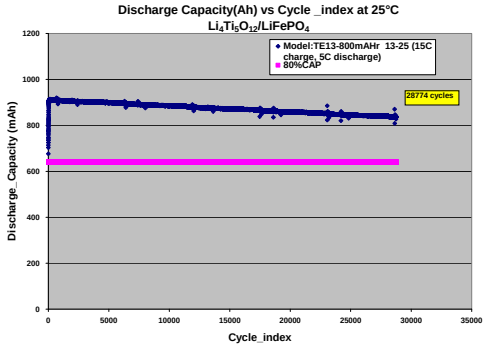

Figure 1. Cycle test result for standard 18650 format cells conducted under 15C charge/5C discharge conditions; the blue dotes line is the 80% SOC line.

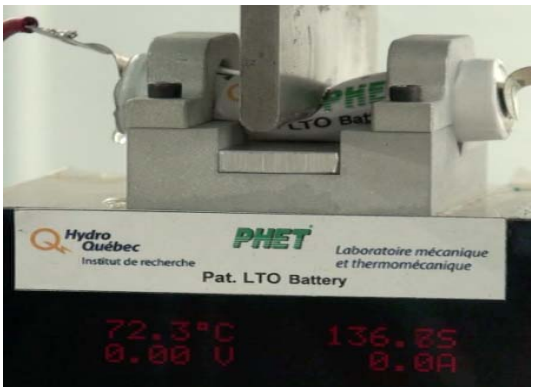

Figure 2. Photograph of a standard 18650 cell after crush test - no smoke and no flames were observed.

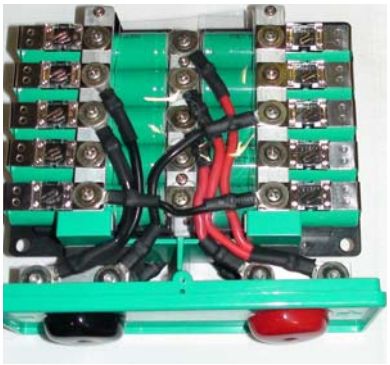

Figure 3. Photograph of a battery pack with the DOSBAS® protection device.