Low Cost Na-ion Battery Technology

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Sodium-ion (Na-ion) batteries represent an attractive alternative to their lithium-ion counterparts, and are expected to offer some significant commercial advantages such as lower materials costs and improved safety characteristics [1,2]. Until recently the problem with the practical realization of sodium-based systems has been the limited availability of suitable anode (negative) and cathode (positive) electrode materials that may reversibly cycle sodium ions [3,4].

In this study we demonstrate the performance characteristics of Na-ion cells constructed using a hard carbon anode material coupled to a proprietary layered oxide cathode electrode. In Figure 1 we depict the voltage profile derived from a typical constant current charge-discharge cycle. These data were collected at 25 ^{o}C using a C/10 rate for both charge and discharge. The cathode material cycles reversibly at a specific capacity of 143 mAh/g and cell generates an average discharge voltage of around 3.0 V.

Figure 2 shows a typical cycle life plot for a representative Na-ion cell. These data were collected at 25 ^{o}C at a C/10 charge/discharge rate using voltage limits of 4.2 and 1.0 V. Following 90 cycles the cell has retained over 93 % of the original discharge capacity. This cycling performance is similar to the capacity fade behavior encountered in commercial Li-ion cells.

The rate performance for a typical Na-ion cell is shown in Figure 3. These data were collected at 25 ^{o}C. At the 5C discharge rate the cell retains more than 50 % of its rated discharge capacity. We consider this to be encouraging rate characteristcs for a test cell which was designed for energy applications and was not optimized for rate performance.

Futher performance data for the Na-ion system will be presented.

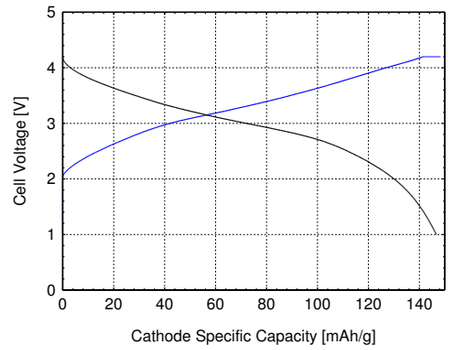

Figure 1: Cell Voltage Profile. Charge–discharge Behavior of a typical Hard Carbon//Layered Oxide Na-ion cell cycled between 4.2 and 1.0 V at a C/10 rate at 25^{o}C.

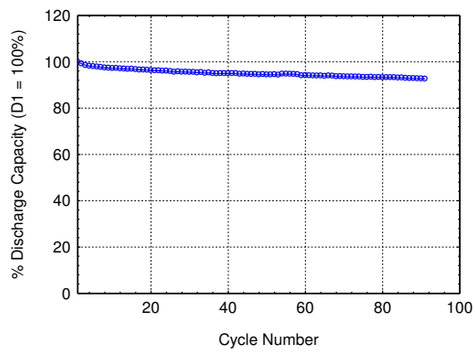

Figure 2: Cycle life profile of a typical Hard Carbon//Layered Oxide Na-ion cell cycled between 4.2 and 1.0 V at a C/10 rate at 25^{o}C

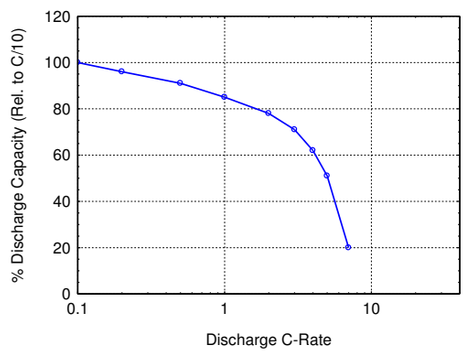

Figure 3: Rate capability (% Discharge Capacity versus Discharge Rate) of a typical Hard Carbon//Layered Oxide Na-ion cell. The cell was tested using voltage limits of 4.2 and 1.0 V at 25^{o}C.

References:

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