Multi-Amp Hour Cell Construction using PSI's Silicon Whisker and Carbon Nanofiber Composite Anode

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Silicon has been an attractive anode material for lithium ion batteries because of its known theoretical charge capacity of 4,200 mAh/g [1]. Despite its capacity advantage over existing graphite anodes (372 mAh/g) and various nitride and oxide materials [2-3], silicon anodes have limited applications because silicon's volume changes by 300% upon insertion and extraction of lithium which results in decrepitation and capacity fading [4].

Under NASA SBIR Phase I and II programs, Physical Sciences Inc. (PSI) successfully developed a silicon whisker and carbon nanofiber composite anode (Figure 1). The nanocomposite design provides a synergistic improvement in reversible capacity and electrochemical cycling as a result of the unique silicon architecture and structural reinforcement provided by the nanofibers. These characteristics have enabled the demonstration of an anode composite capacity of greater than 1100mAh/g for over 200 cycles (100% depth-of-discharge) at 1C rates. Further the developed powder can be handled and processed into electrodes using established procedures and equipment.

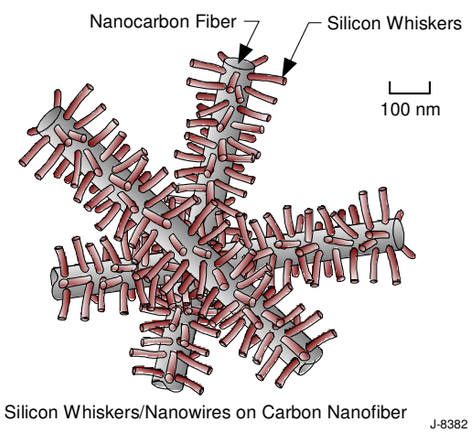

Figure 1. Proposed silicon whisker on carbon nanofiber composite structure.

In this presentation, we will present on our efforts to construct high energy density cylindrical and prismatic cells with this anode material. Figure 2 shows the results of initial charge/discharge testing of an 18650 cylindrical cell incorporating PSI's anode material. The results from testing at each cell size (coin, pouch, and cylindrical) will be discussed. In particular, the impact on cycling performance of the cathode material and electrolyte choice will be examined.

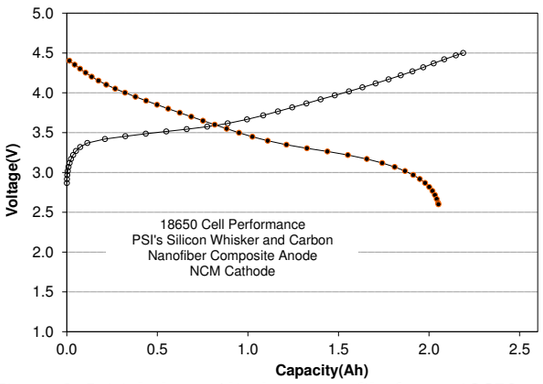

Figure 2. Initial charge/discharge profile for an 18650 cell incorporating PSI's silicon whisker and carbon nanofiber composite anode material.

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References

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