Electrochemical and Thermal Behavior of Graphite Anode Material for Li-ion Batteries

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Carbonaceous materials have been studied as anode materials for lithium-ion batteries. The application of carbonaceous materials instead of Li-metal has several advantages such as better cycle life and reliability of the cells by preventing severe degradation problems associated with the metallic lithium/solvent interface and avoiding dendrite formation during cycling. Among various carbonaceous materials, natural graphite appears to be a suitable candidate due to its high reversible capacity (372 mAh/g in LiC_6), low and flat potential profile, and low cost. [1-3]

The practical reversible capacity is one of the most important factors to determine the performance of the graphite electrode. Another factor is the irreversible capacity loss associated with SEI film formation that is always observed during the first cycle.[4] It is desirable to develop the graphite materials with high reversible capacity and low irreversible capacity loss. The development of better graphite materials requires better and clearer understanding of lithium intercalation process in graphite materials.

A series of natural graphite samples were prepared and provided by Superior Graphite Co., which use a proprietary thermal purification technology (without acid leaching) to produce graphite with very high purity without acid leaching.

Powder X-ray diffraction (XRD) measurements were performed to analyze the crystal structure. Electrochemical cycling of the graphite materials was performed with a BT-2043 Arbin cycler at C/20 rate using a 2016 coin-cell consisting of Li-metal as a reference and a counter electrode and $LiPF_6$ in mixture of EC+DEC.

The thermal stabilities of the graphite samples were investigated by Differential Scanning Calorimetry (DSC).

Figure 1 shows the XRD patterns of graphite samples (SO3427, SO34117 and SO34119). Among the natural samples, SO34117 and SO34117 show the sharp peak (002), indicating the high degree of graphitization. Figure 2 shows the initial Li interaction/deintercalation curves of Li/SO4119 cells at a constant charge/discharge current rate of C/20 over the potential range of 1 to 0V. The sample SO34119 exhibits 335 mAh/g of reversible capacity in the voltage range. The irreversible capacity at the first cycle is approximately 16 %, based on the first intercalation capacity.

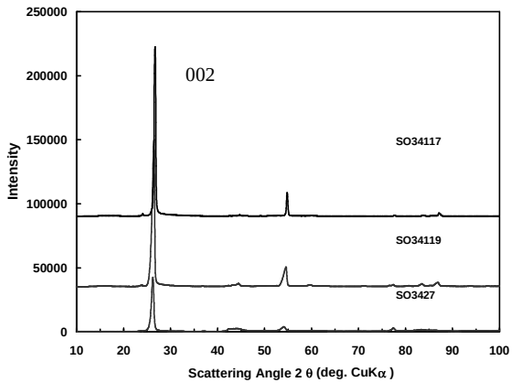

Figure 1: X-ray diffraction patterns of graphite samples (SO3427, SO34117, and SO34119)

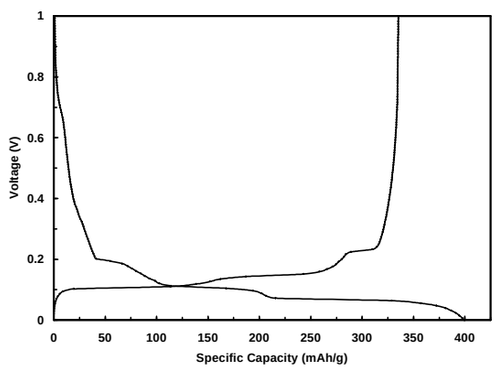

Figure 2: First Charge/Discharge curves of Li/ 1M $LiPF_6$ in EC+DEC/ SO34119

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