

**Lithium Insertion into Multi-Walled Carbon
Nanotubes/Silicon Composite**

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Carbon nanotubes (CNTs) with a 1D host lattice have received much attention as a Li insertion host material in higher energy density Li-ion rechargeable batteries. It is well reported that the reversible Li storage capacity (C_{rev}) of two types of CNTs, multi-wall carbon nanotubes (MWNTs) and single-wall carbon nanotubes (SWNTs) is greatly enhanced by various processing methods such as thermal and chemical treatments. However, the large irreversible capacity (C_{irr}) and the large hysteresis of CNTs was a limiting factor as the Li insertion host material. It is also well known that Si can alloy with Li up to 4.4 Li per Si at high temperature, which is equal to a Li storage capacity of 4000 mAh/g. But the reversibility of normal Si powder at room temperature is poor.

In this presentation we report the Li insertion properties into the MWNTs/Si composites. MWNTs/Si composites were synthesized by the high energy ball-milling process using the purified MWNTs and Si powder as a function of the Si content. And then, MWNTs/Si composites were electrochemically inserted with Li. The C_{rev} of the MWNTs/Si composites were increased from 351 mAh/g ($Li_{0.9}C_6$) for the purified MWNTs to 1770 mAh/g ($Li_{4.8}C_6$) at the 50 wt.% Si content. On the other hand, the C_{irr} of the MWNTs/Si composites were decreased from 1012 mAh/g ($Li_{2.7}C_6$) for purified MWNTs to 469 mAh/g ($Li_{1.3}C_6$) at the 50 wt.% Si content. MWNTs/Si composites had a low voltage profile during the charge/discharge process, indicating small hysteresis was observed in the MWNTs/Si composites. MWNTs were reacted as the conductive agents and the Li insertion host during formation alloy of Si with Li in the charge/discharge process.