Lithium Ion Battery using Multi-Walled Carbon Nanotubes Thin Film as anode material

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Since first discovery by Ijima [1] at 1991, much effort has been made to assess the capability of lithium storage using carbon nanotubes (CNTs) [2-5]. In the past decade, both single-walled and multiwalled CNTs (MWCNTs) have been studied because of their interesting properties. In this paper, we report the electrochemical properties of the directly assembled carbon nanotubes thin film as anode materials for lithium ion battery.

The MWCNTs thin film in this experiment was synthesized by the catalyst-assisted chemical vapor deposition (CVD) method. Thin layers of Al followed by Ni were sputtered onto silicon substrate. The Ni thin film was first heated at 600 ℃ under argon(60sccm) and hydrogen(20sccm) gas mixture for 1hr. MWCNTs were then deposited at 700 ℃ for 5min on the Ni-coated substrate with a mixture of methane (20sccm),.argon (60sccm) and hydrogen (20sccm). The cyclic voltammogram (CV) test conducted in this study adopted the two-electrode lithium cell, which was assembled in a glove box fed with argon gas. Lithium and carbon nanotubes thin film was used as the counter and the anode, respectively. The electrolyte consisted of 1M LiPF6 dissolved in a 50/50 volume percent mixture of ethylene carbonate and dimethyl carbonate. The electrochemical test was controlled by an EG&G 273 potentialstat .

Fig1 shows a high-resolution transmission electron microscope (HRTEM) image of MWCNTs in which the diameter was about 15nm. The parallel fringes showed that the MWCNTs were well graphitized. The CV result for the first two cycles on a MWCNTs/Li cell is shown in Fig. 2. The potential was scanned linearly with time, at a step of 0.5mV/s, from 0 V to 3 V. The results showed no irreversible peaks in the cathodic branch of the first cycle CV test. This result was similar to that reported by Agnes S. Claye et al [2], who used single wall carbon nanotubes as anode materials. Furthermore, as the scan cycle increased the current increased correspondingly; but the underlying mechanism was not well understood. We suppose it may be due to an increase in the rate of lithium insertion and extraction. In summary, these characteristics give a strong indication that the lithium insertion and extraction are highly reversible in the MWCNTs synthesized by CVD.

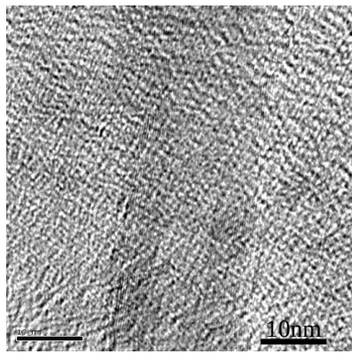

Fig1 HRTEM image of a MWCNT.

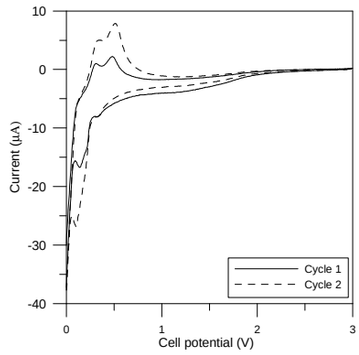

Fig 2. Cyclic voltammogram (0.5mV/s) for a MWCNTs/Li cell.

References:

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