The Filled Carbon Nano-tube Composite with Sn Used as Anodes for Lithium-ion Battery

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As a new anode alternative material for lithium-ion battery, the carbon nanotubes (CNTs) and Sn have ever been widely investigated before[1-2]. But unfortunately, the both of them were proved to be poor electrochemical performance comparing to current carbonaceous materials[3-4]. CNTs are attracted as a constitute of novel nanostructure materials due to their many unusual mechanical, electronic, physical, and chemical properties. Tin has been investigated used as anode in lithium ion battery and exhibited the initially high Li ion alloying and de-alloying capacity, but unfortunately its cyclability was so bad that it can not be applied for any commercial purpose. In present work, tin was filled into CNTs to prepare so call Sn-CNT composite. The CNT was used as a matrix, Sn as an electrochemically active phase to lithiation and de-lithiation and the large Li-driven volume swells from Sn were successfully suppressed by this way.

The CNT was prepared by catalytic pyrolysis of acetylene based on template methods. The aluminum oxide template was pretreated by immerging in solution of $FeSO_4$ for 15 min and taking it out followed by washing and drying. Then the template was put in a horizontal oven namely a quartz tube (Φ5cm, length 140cm), the temperature of which can be adjusted by the program temperature controller. The mixture gases of H_2, N_2 and C_2H_2 were introduced to the quartz tube at 20 ml/s. The filled CNT was prepared by immerging the CNT into $SnCl_2$ solution with stirring for 24hs. After washing and drying the remains were reduced in oven at 700℃ by H_2. The filled CNT were characterized by XRD, TEM, DTA etc, and their electrochemical performances were investigated employing the testing cells.

The results showed that the filled CNT demonstrated the advantages of CNT or Sn and eluded the disadvantages from CNT or Sn exclusive anode in Li-ion battery. It possesses high reversible capacity and excellent cycle life, as an innovative anode for lithium battery, the filled CNT by Sn is a hopeful materials for high rate discharge and large size battery because of its good electronic conductivity and safety.

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References

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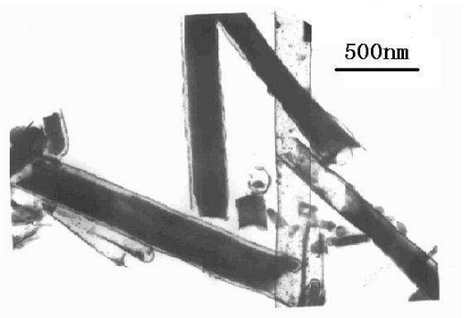

Fig. 1 TEM of CNT and filled CNT

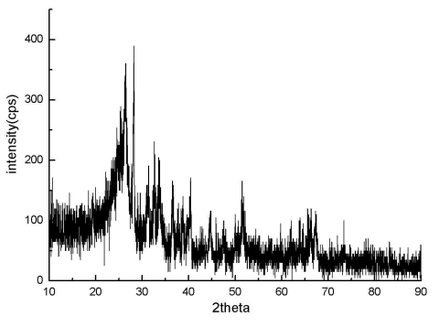

Fig. 2 XRD of filled CNT

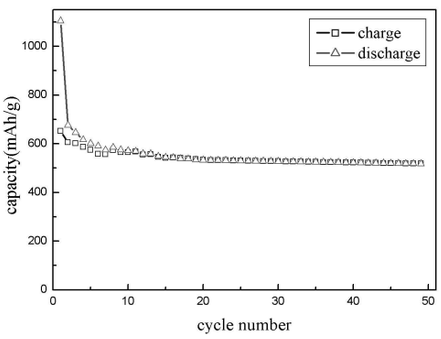

Fig.3 Curves of cycle life of test cell using filled CNT as a working electrode incorporated a lithium metal counter electrode

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