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Sn/Al_2O_3/C/CNT composite prepared by wet milling as anode material for rechargeable lithium ion cells

C.P Sandhya[1], Bibin John[2]* and C. Gouri[2]

[1]Lithium-ion and Fuel Cell Division, Vikram Sarabhai Space Centre, Thiruvananthapuram-695022, Kerala, India
[2]Advanced Energy Systems Division, Vikram Sarabhai Space Centre, Thiruvananthapuram-695022, Kerala, India
*Email: bbnjohn@yahoo.com

The energy crisis associated with uncontrolled population is one of the major challenges to the scientific world. A large amount of research has focused on developing next generation high energy sources. Li-ion batteries with high specific capacity and excellent cycle performance are the best candidates to meet the energy crisis presently facing the society. Graphite based anode materials are commonly employed in Li-ion batteries. Being limited in capacity (372 $mAhg^{-1}$), the material need to be replaced with some high capacity alternatives [1]. Tin with a high theoretical capacity of 993 $mAhg^{-1}$ has been proposed as an alternative anode material [2]. However, the electrical disconnection from current collector as a result of large volume changes during the alloying and de-alloying process leads to poor cyclability [3]. Several strategies including nanosized active material, intermetallic compounds, Sn/C nanotubes and Sn-inactive matrix composites were adopted to improve the mechanical stability. There are reports regarding the use of some electrochemically inactive material such as Al_2O_3 as a matrix, which can buffer the huge volume changes associated with alloying and de-alloying process.

In the present study, we report a simple wet milling route for the synthesis of Sn/Al_2O_3/C/CNT (SAC/CNT) nanocomposite. The structural and morphological properties of the nanocomposite is characterised by X-ray diffraction and Scanning Electron Microscopy. Electrochemical performance studies have been carried out using Cyclic Voltammetry, charge-discharge cycling and Electrochemical Impedance spectroscopy techniques. A broad comparison of these results with those for Sn/C (SC) and Sn/Al_2O_3/C (SAC) are also done. The charge-discharge curve of SC, SAC and SAC/CNT are depicted in Figure 1. The SAC/CNT material delivered an initial capacity of 835 $mAhg^{-1}$ with a coulombic efficiency of 77 %. In addition this material exhibited better cycle performance. Thus, SAC/CNT exhibited better specific capacity and cycling performance compared to SC and SAC (Figure 2).

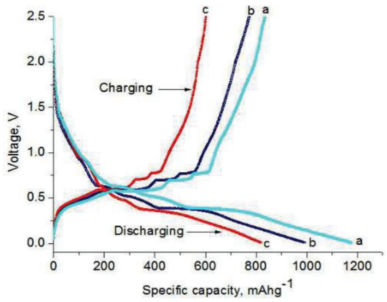

Figure 1: Typical charge-discharge curves of (a) SAC/CNT, (b) SAC and (c) SC (Potential window: 0.01- 2.5 V)

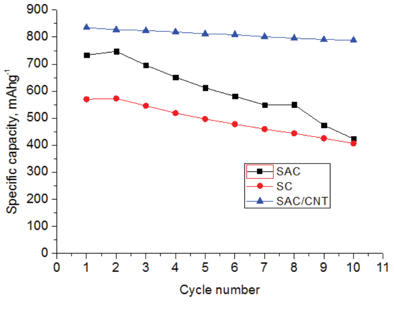

Figure 2: Cycling performance of SAC/CNT, SAC and SC

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