

Lithium Intercalation and Deintercalation on SnO-Carbon Nanotube Composite

Mao-Hui Chen*, Guo-Tao Wu, Guang-Ming Zhu, Jin-Kua You, Zu-Geng Lin

State Key Lab for Physical Chemistry of Solid Surface and Department of Chemistry
Xiamen University, Xiamen, Fujian 361005, China

*correspondent author: mhchen8@xmu.edu.cn

As promising anode materials applied in lithium ion battery, tin oxide usually exhibits high reversible capacity but very short cycle life[1], while carbon nanotube, in other hand, shows good cycle stability but large irreversible capacity lose[2]. This mutual indemnification in performance hints us to combine them together to pursue good over-all properties. In the present work, we prepared SnO-carbon nanotube composites (SnO-CNT) by coating SnO on carbon nanotubes, and examined their predominance to pristine SnO and carbon nanotubes.

The coating operation is a sol-gel process in which $H_2C_2O_4$ precipitant was added dropwise into carbon nanotube suspended $SnCl_2$ solution. After filtration and drying, the mixed solid was calcinated at 1173K. SnO was synthesized by the similar sol-gel method. Carbon nanotube was prepared by pyrolysis of acetylene at 1023K over Co/SiO₂ catalyst. A three-electrode test cell was designed for electrochemical measurements, in which Li metal was used both as counter electrode and reference electrode, 1M LiPF₆ in EC/DEC(1:1) solution was used as electrolyte.

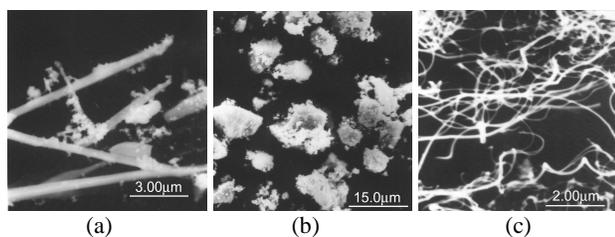


Fig. 1 SEM pictures of (a) SnO-CNT, (b) SnO and (c) CNT

Fig. 1 shows the morphologies of the samples. It can be seen clearly that in the SnO-CNT sample, SnO is covering the surface of carbon nanotube uniformly. Although there are some SnO particles adhered, the size is much smaller than that of pristine SnO.

The cycle properties of the three samples are compared in Fig. 2. Obviously, SnO-CNT shows a much higher specific capacity than pristine SnO and carbon nanotubes. Simultaneously, it shows a better durability against decay than pristine SnO. It demonstrates the composite of tin oxide and carbon nanotubes has a great benefit on anode performance. We attribute this existing result to the good dispersion of SnO on carbon nanotubes, as we believe the well-dispersed SnO has a high utilized coefficient, and the produced thin layer or small particle size is helpful in releasing the stress caused by drastic volume variation during lithium intercalation or deintercalation.

In Fig. 3, we introduced a concept of relative irreversible capacity. It was defined as the difference of discharge capacity (C_{dng}) and charge capacity (C_{chg}) at same cycle divided by discharge capacity, i.e. $(C_{dng}-C_{chg})/C_{dng}$. It means how many percent of the intercalated lithium in each cycle can not be deintercalated. As it is shown, the relative irreversible capacity of SnO-CNT is

the lowest in the three samples. This results indicates SnO coating may hinders the SEI formed on the surface of carbon nanotubes for the sample SnO-CNT, hence can reduce greatly irreversible capacity and improve the charge capacity at the same time.

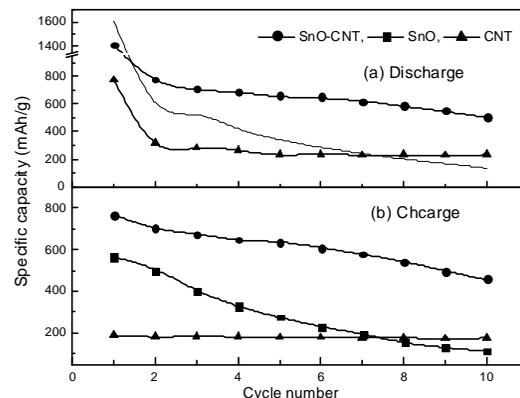


Fig.2. The (a) discharge and (b) charge capacity varies with cycle number for SnO-CNT composite, the pristine SnO and carbon nanotubes

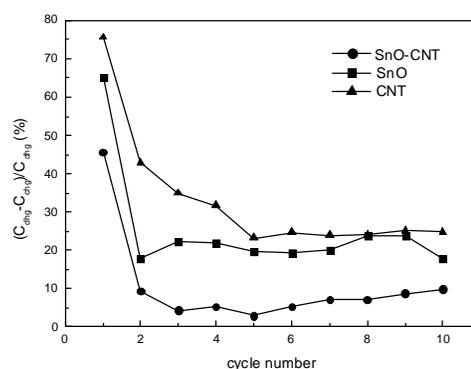


Fig.3. Comparison of the relative irreversible capacity of the three samples

Acknowledgment

The work reported were financially supported by the Natural Science Foundation of Fujian Province.

References

1. Y. Idota, T. Kubota, A. Matsufuji, Y. Maekawa, T. Miyasaka, *Science* 276(1997) 1395
2. G. T. Wu, C. S. Wang, X. B. Zhang, H. S. Yang, Z. F. Qi, P. M. He, W. Z. Li, *J. Electrochem. Soc.* 146(5) 1696-1701 (1999)