A Critical Size of SnO_2 Nanoparticles for Li-Ion Cells

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Recently, many efforts have been made to improve the electrochemical properties of SnO_2 electrode for Li-ion cells [1-4]. Li *et al.* reported that SnO_2 nanofibers protruding from a current-collector surface effectively accommodated the volume change [2]. This anode material retained excellent cycling stability at the high C rate. Thin-film SnO_2 was also studied for the same purpose [3,4]. However, these electrodes are not economically feasible for Li-ion cells.

SnO_2 nanocrystals with a different size, ~3 and ~8 nm, were synthesized using $SnCl_4$ and triethylenediamine (TEDA) as a structural-directing agent by hydrothermal method at 110°C and 200°C, respectively (Fig. 1). Their electrochemical properties were measured using coin-type half cells (2016 type). Results showed that ~3 nm-sized nanoparticles had superior capacity and cycling stability compared to ~8 nm-sized ones. The ~3 nm-sized SnO_2 nanoparticles exhibited initial capacity of 740 mAh/g with negligible capacity fading even at a high rate of 1800 mA/g (Fig. 2). The electrochemical properties of ~3 nm-sized SnO_2 nanoparticles were superior to those of thin-film analogues. TEM and XRD confirmed that ~3 nm-sized SnO_2 after 30 cycles did not aggregate into large Sn clusters and maintained its particle size, in contrast to the ~8 nm-sized one.

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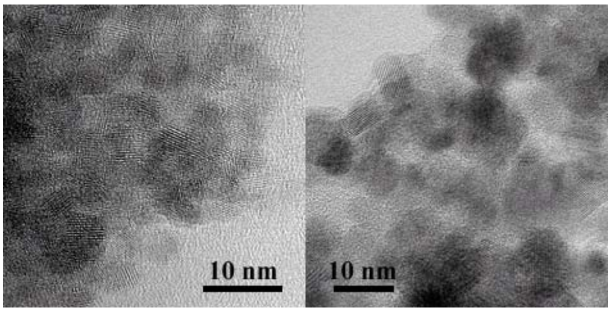

Figure 1. TEM images of SnO_2 nanoparticles with an average particle size of ~3 nm (left) and ~8 nm (right).

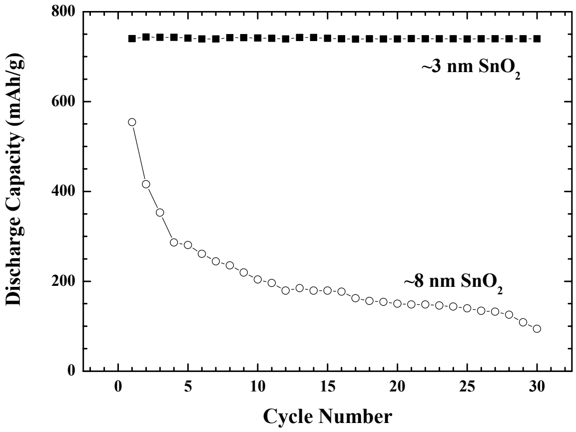

Figure 2. Capacity retention of SnO_2 nanoparticles cycled at the discharge rate of 300 mA/g and charge rate of 1800 mA/g between 0 and 1.2 V.

References

1. T. Kim, D. Son, J. Cho, B. Park, and H. Yang, *Electrochmica. Acta.* (2004).
2. N. Li, C. R. Martin, and B. Scrosati, *Electrochem. Solid-State Lett.* **3**, 316 (2000).
3. R. Retoux, T. Brousse, and D. M. Schleich, *J. Electrochem. Soc.* **146**, 2472 (1999).
4. S. C. Nam, Y. H. Kim, W. I. Cho, B. W. Cho, H. S. Chun, and K. S. Yun, *Electrochem. Solid-State Lett.* **2**, 9 (1999).