Excellent cycle performance of SnO$_2$-TiO$_2$/graphene composite as anode materials for lithium ion batteries

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Lithium-ion batteries have been viewed as the promising power sources of electronic/hybrid vehicles, owing to their high energy density and high electromotive force [1]. Graphite is the widely commercial anode material, but its theoretical specific capacity is only 372 mAhg$^{-1}$, which cannot fulfill the increasing demand for lithium-ion batteries with higher energy density [2]. To address this problem, many efforts have been devoted to investigate new metal oxide/graphene composites [3,4]. The SnO$_2$-TiO$_2$/graphene composite shows excellent cycle performance as anode materials for lithium-ion batteries.

SnO$_2$-TiO$_2$/graphene composite was prepared by primal materials graphene oxide, SnCl$_2$·2H$_2$O and Ti(OC$_3$H$_7$)$_4$ through a simple wet chemical method. Graphene oxide (GO) was prepared from natural graphite according to the Hummers method. The graphene oxide was reduced to graphene and flower-like SnO$_2$-TiO$_2$ nanoparticles were homogeneously distributed on the matrix of graphene nanosheets. The content of graphene was about 31 wt% according to thermogravimetric analysis in air. The SnO$_2$-TiO$_2$/graphene delivers the first discharge capacity of 1622 mAhg$^{-1}$ and charge capacity of 841 mAhg$^{-1}$, showing a coulombic efficiency of 52%. The large initial capacity loss mainly due to stable SEI formation on SnO$_2$-TiO$_2$/graphene nanosheets. The as-prepared SnO$_2$-TiO$_2$/graphene composite shows superior cycling performance stabilized at 730 mAhg$^{-1}$ for 30 cycles at a current density of 200 mA·g$^{-1}$. Because the TiO$_2$ in the SnO$_2$-TiO$_2$/graphene not only works as a mechanical support, which effectively buffers the volume changes of tin during lithium ion intercalation/de-intercalation, but also protects the tin crystals from agglomeration during the charge–discharge cycling. In summary, the SnO$_2$-TiO$_2$/graphene composite can have wider applications in the fields of energy storage and conversion.

References