Abstract

The exploitation of high-performance lithium ion batteries is an effective way to promote the practicality of electric vehicles and the large scale development of renewable energy. We have designed and used a low temperature solution approach which is simple, low cost, scalable to synthesize Zn$_2$GeO$_4$/g-C$_3$N$_4$ hybrid structure. Furthermore the synergistic effect on their lithium storage has been discussed. The Zn$_2$GeO$_4$/g-C$_3$N$_4$ hybrids exhibited highly reversible capacity of 1370 mA h g$^{-1}$ at 200 mA g$^{-1}$ after 140 cycles and excellent rate capability of 950 mA h g$^{-1}$ at 2000 mA g$^{-1}$. On the other hand, molybdenum sulfide, one of the transition metal sulfides, has been considered as a hopeful anode material, because of the small volume change (∼103%) and the high theoretical capacity (669–1675 mA h g$^{-1}$). In order to improve the electrochemical properties of molybdenum sulfide, we have designed and prepared TiO$_2$@MoS$_2$ core-shell structure. This composite structure provides a plenty of surface active sites for rapid transportation of lithium ions and orderly path for electrons. As a result, the electrochemical performance of TiO$_2$@MoS$_2$ is much higher than that of molybdenum sulfide as well as titanium dioxide. In addition, transition metal oxides also have been attracted widespread attention, because of it versatile nanostructures, high theoretical capacity and small volume change. We have synthesized 3D NiO microsphere architecture assembled from porous nanosheets via easy hydrothermal method. The advantage of large specific surface area endows the as-prepared 3D NiO microspheres with a good performance of stable and high reversible discharge capacity up to 820 mA h g$^{-1}$ even after 100 cycles at a current density of 100 mA g$^{-1}$, and good rate capability of 634 mA h g$^{-1}$ at a high current density of 1 A g$^{-1}$.

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