Reduced Porous Graphene Oxide Based Nanocomposite Materials as High Performance Lithium-ion Battery Electrodes

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Abstract

Reduced graphene oxide based nanocomposites attracted much attention as electrode materials for energy storage devices. To improve the electrochemical performance even further, recent research has focused on the preparation of porous structures. Reduced Porous graphene oxide allows for rapid ion diffusion and displays high real surface area. Here, our recent work in reduced porous graphene oxide based nanomaterials for lithium-ion battery electrodes is reported.

A composite of reduced porous graphene oxide and $LiFePO_4$ has been developed to improve the speed of charging-discharging, and the cycling stability of lithium ion batteries using $LiFePO_4$ as a cathode material.[1] Reduced porous graphene oxide has been successfully synthesized via activation by KOH. The as–prepared reduced porous graphene oxide was mixed with $LiFePO_4$ to prepare the composite. Microscopic observation and nitrogen sorption analysis have revealed the surface morphologies of reduced porous graphene oxide and the reduced porous graphene oxide/$LiFePO_4$ composite. Electrochemical properties have also been investigated after assembling coin cells with the reduced porous graphene oxide/$LiFePO_4$ composite as a cathode active material. Interestingly, reduced porous graphene oxide/$LiFePO_4$ composite has exhibited better electrochemical properties than conventional graphene/$LiFePO_4$ composite as well as bare $LiFePO_4$, including exceptional speed of charging-discharging and excellent cycle stability. That is because the reduced porous graphene oxide in the composite provides abundant porous channels for the diffusion of lithium ions. Moreover, it acts as a conducting network for easy charge transfer and as a divider, preventing the aggregation of $LiFePO_4$ particles. Owing to these properties of reduced porous graphene oxide, $LiFePO_4$ could demonstrate enhanced and stably long–lasting electrochemical performance.

Although MoS_2 has a high theoretical capacity than graphite as an anode material for Lithium-ion battery, its intrinsic poor electrical/ionic conductivity decreases rate property and lithium storage capacity. In this work, we prepared MoS_2/reduced porous graphene oxide composite by solvothermal method to complement conductivity and improve lithium storage properties of MoS_2.[2] Reduced porous graphene oxide was synthesized by convenient, low-cost, and mass-producible nitric acid treatment method. Due to its enlarged surface area and porous structure, MoS_2/reduced porous graphene oxide sample exhibited improved capacity and cyclic stability than other MoS_2/reduced graphene oxide and MoS_2 nanoparticle samples. After 100 cycles, MoS_2/reduced porous graphene oxide electrode shows improved capacity of 932 mA h g^{-1} while capacity of MoS_2/reduced graphene oxide electrode is 395 mA h g^{-1} at 200 mA g^{-1}.

References

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