Graphene for High-Performance Lithium Storage

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Abstract

Electrochemical energy storage devices, in particular, lithium-ion batteries and lithium-sulfur batteries, have been extensively explored in response to the ever-increasing demand for clean energy and climate change mitigation technologies. Graphene with different structures and functionalities plays a key role in these energy storage devices for use as electrodes, conductive fillers, coating layers, etc. Graphene has a unique two-dimensional structure, good electrical conductivity, high strength, and desirable chemical stability. Therefore, It is expected to find extensive and important applications in the field of electrochemical energy storage.

We have fabricated a series of graphene-based hybrid electrode materials by mechanical mixing, hydrothermal deposition, and *in-situ* growth. These hybrid electrode materials showed desirable electrochemical properties in terms of long cycling life, good high rate capability, and high reversible capacity. The working mechanism of graphene in hybrid electrodes was investigated by an *in situ* TEM approach. It was found that graphene takes a significant role in forming electrical conductive network and preventing the volume expansion of active materials. And we also designed and developed graphene-based sandwich structure, integrated structure and flexible structure for high-capacity, high-power, long-life and high energy lithium-sulfur batteries.

Using graphene in flexible energy storage devices is another emerging field, and we have also explored several kinds of graphene-based flexible electrodes. For example, by coating active materials on a graphene foam-like structure synthesized by CVD, an anode and cathode were made to assemble a thin, lightweight and flexible lithium ion battery, which show high rate capability and capacity, and excellent flexibility.