Sulfur-Doped Carbon Materials Derived from Waste-Car-Tire for High Performance Lithium-Sulfur Battery

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As one of the most promising electrical energy storage (EES) devices, lithium-sulfur (Li-S) batteries have been paid more and more attention. The high theoretical capacity of sulfur (1675 mAh g-1) leads to a high theoretical energy density (2600 Wh kg-1) of Li-S batteries. However, there are still some problems restrict the commercial application of Li-S batteries, such as the “shuttle effect” caused by highly soluble intermediate lithium polysulfide species, low utilization of active materials, and the volumetric expansion of sulfur cathode during the charge/discharge process. In this work, I propose an efficient method to prepare sulfur-doped carbon materials from the waste car tires. The sulfur-crosslinked rubber in the waste car tires can serve as the sulfur and carbon resources to form car tire carbon (CTC) with sulfur doping. The scanning electron microscope (SEM) observation and the energy dispersive spectrometer (EDS) analysis results show that the CTC has a hierarchically porous structure with evenly distributed sulfur content. When used as a kind of coating for the Li-S battery separator, the CTC can restrain polysulfide and improve the electrochemical performance of Li-S batteries. I used the CTC-coated separator to assemble Li-S batteries and investigated the improvement in electrochemical performance by galvanostatic charge/discharge test. My Li-S batteries show high capacity retention (about 94%) after long cycling (300 cycles) under a large current rate (1C). This project will not only provide an efficient method to recycle the waste car tires but also supply a novel strategy to prepare sulfur-doped carbon materials for high-performance Li-S batteries.

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