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Separators with Active-Carbon Coating for Advanced Lithium–Sulfur Batteries

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Lithium–sulfur (Li–S) batteries have a large theoretical energy density and high theoretical capacity. However, practical applications of Li–S batteries are limited by cycling instability and low rate performance, which mainly originate from the intrinsic poor conductivity of sulfur and the dissolution of polysulfides generated during discharge–charge cycles. In this work, we demonstrate a low-cost, facile and effective strategy to modify separators with an active carbon layer. The carbon-coated separator can significantly increase the specific discharge capacity and improve cycling stability of the cathode prepared by the S powder and the active carbon. For example, the initial discharge capacity of the S cathode reaches up to 1452 mAh g^{-1} at 0.2 C with a low fading rate of 0.15% per cycle within 400 cycles. Moreover, when the rate is increased to 1 C, the S cathode can still deliver a discharge capacity of 1009 mAh g^{-1}. The enhanced electrochemical performance can be attributed to the excellent conductivity and strong adsorption capability of the active carbon coating, which effectively suppresses the shuttle effect of polysulfides. The electrochemical analysis confirmed the long cycle life, excellent rate performance, and high discharge capacity of the Li–S cells.

Keywords: separator; active carbon; polysulfide adsorption; lithium-sulfur battery

FULL TEXT