(Research Article 6)

"Flexible hierarchically PANI/MnO_2 porous network with fast channels and extraordinary chemical process for stable fast-charging lithium-sulfur battery"

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Abstract:

Lithium–sulfur batteries with high theoretical specific capacity are quite promising in energy storage systems. The application of lithium–sulfur batteries however has mainly been hampered by the severe shuttle effect of polysulfides during the charging/discharging process. Here, we report the in situ self-assembling of ultra-thin flexible polyaniline layer decorated manganese dioxide nanoparticles (PANI–MnO_2) to form a three-dimensional hierarchically porous network as a sulfur host for lithium–sulfur batteries. The hierarchically porous PANI–MnO network not only provides a porous structure to alleviate the volume expansion, but also offers fast channels to accelerate the transfer of active species, electrons and ions to improve the redox reaction kinetics. The as-fabricated PANI–MnO_2–S electrode thus demonstrates excellent electrochemical performance, with a stable capacity up to 1195 mA h g^{-1} at 0.5C after 100 cycles. In particular, the hierarchically porous PANI–MnO_2 network employs an extraordinary chemical process for polysulfides to form active thiosulfates, which are further converted into Li_2S. This significantly suppresses the shuttle effect, thus providing the possibility for fast charging. As a result, the PANI–MnO_2–S electrode exhibits a discharge capacity of 640 mA h g-1 at 2C after 500 cycles. Even at a high sulfur loading of 4.0 mg cm^{-2}, a stable areal capacity of 3.12 mA h cm^{-2} is achieved at 1C after 200 cycles.