LI–S BATTERIES

Passivating Li metal

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Li–S rechargeable batteries are one of the most promising types of next-generation battery because of their high theoretical energy density. So far, most efforts in the development of Li–S batteries have focused on the issues related to the S cathode, such as the insulating nature of elemental sulfur and the formation of intermediate polysulfides. Recently, metallic Li anodes have received intensive research attention to help enable the realization of the full potential of Li–S batteries. However, challenges associated with the metallic Li anode, such as Li dendrite growth and the resultant low cyclability, still remain. Now, Wonbong Choi and colleagues in the United States present a simple but effective approach of coating the Li metal anode with a 2D MoS_2 layer to achieve a high-performance Li–S battery. By pairing the MoS_2-protected anode with a S–carbon nanotube composite cathode, the researchers report an energy density of 589 Wh kg^{-1} and 1,200 stable cycles at 0.5 C.

The MoS_2 layer, about 10 nm thick, was made using a sputtering deposition technique. MoS_2 particles distribute uniformly over the Li metal surface, avoiding uneven electric resistance that could trigger Li dendrite growth during the device operation. According to density functional theory simulations, Li ions could rapidly diffuse on the MoS_2 surface, also helping to suppress Li dendrite growth. In addition, the coating layer undergoes a phase transition from a trigonal prismatic morphology to an octahedral morphology during the electrochemical cycling. This increases the electronic conductivity of the MoS_2 layer and lowers the interfacial resistance, ultimately improving the cycling stability. Finally, the MoS_2 coating layer adheres tightly to the Li metal surface, which helps in maintaining the ionic conductivity over cycling. All these factors contribute to the high performance.

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