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Regulation Polysulfide Conversion by Flexible Carbon Cloth/Molybdenum Selenide to Improve Sulfur Redox Kinetics in Lithium-Sulfur Battery

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Lithium-sulfur (Li-S) batteries have been regarded as a competitive candidate for next generation electrochemical energy-storage technologies. However, the insulation of charge and discharge products (sulfur and lithium sulfide) and the shuttle efforts of lithium polysulfides (LiPSs), result in not only a series of phase conversion but also sluggish redox kinetics in Li-S electrochemistry. Herein, we firstly designed a flexible carbon cloth/molybdenum selenide (CC/$MoSe_2$) by growing ultra-thin $MoSe_2$ nanosheets on CC as binder-free electrode to understand the regulation mechanism in Li-S battery. With systematic electrochemical investigation of in-situ deposition Li_2S_8 in CC/$MoSe_2$, it is found that CC/$MoSe_2$ exhibits high LiPSs chemical adsorption and electrocatalytic activity, which large enhances the LiPSs conversion. The dynamic regulation of LiPSs change the nucleation and growth of Li_2S, resulting in high uniform distribution on CC/$MoSe_2$ electrode. Thus, it obtains high sulfur redox kinetics and utilization, which achieves initial capacity of 1142 mAh g^{-1} with low capacity fade of only 0.038 % per cycle over 500 cycles at 1 C. Even at high S loading (4 mg cm^{-2}) and extremely low electrolyte/S (E/S) ratio of 6.2 µL mg^{-1}, it still delivers 1204 mAh g^{-1} after 100 cycles at 0.2C with 93.3% capacity maintain.

Keywords: Molybdenum selenide; Binder-free electrode; Lithium sulfide; Lean electrolyte; Lithium-sulfur battery

FULL TEXT