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Tannic Acid Tuned Metal-Organic Framework as a High-Efficiency Chemical Anchor of Polysulfide for Lithium-Sulfur Batteries

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Abstract

Despite of great progress in lithium-sulfur (Li-S) batteries, shuttle effect caused by long chain polysulfides, as one of the most serious obstacles, needs to be urgently solved for potentially commercial application of Li-S batteries. Herein, we report on an effective strategy to tune surface functional groups and porous structure of Metal Organic Frameworks (MOFs) to efficiently anchor polysulfides for high-performance Li-S batteries. Tannic acid (TA) tuned Zeolitic Imidazolate Framework-67 (ZIF-67) could create uniformly polar sites for in-situ polysulfide absorption, and C-S and Co-S abundantly functional groups for chemically trapping polysulfides for achieving stable cycling performance. Furthermore, TA tuned ZIF-67 polyhedrons can be sculptured to a core/shell hierarchical porous structure. Foremost, the functionalized polar hydroxyl groups can undergo redox reaction with long polysulfides to form thiosulfate and short insoluble polysulfides, relieving the shuttle effect. ZIF-67-5-S cathode exhibits superior cycling stability and rate capability, showing a steady capacity of at 521 mAh/g after 550 cycles under a current density of 500 mA/g, still maintaining a capacity of 510 mAh/g even at a current density of 1600 mAh/g. The TA polymer etching MOFs route to tune core-shell hierarchically pores and abundantly functional groups offers a potential use in high energy Li-S batteries.

Keywords: metal organic framework; hierarchical porous structure; Li-S battery; surface functionalization; chemical immobilizing effect