Hierarchical Defective $Fe_{3-x}C$@C Hollow Microsphere Impulses Fast and Long-lasting Lithium-Sulfur Batteries

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Lithium-sulfur (Li-S) batteries present one of the most promising energy storage systems owing to their high energy density and low cost. However, the practicalization of Li-S batteries is still hindered by several technical issues mainly represented by the notorious polysulfide shuttling and sluggish sulfur conversion kinetics. In this work, we developed the unique hierarchical $Fe_{3-x}C$@C hollow microsphere as advanced sulfur immobilizer and promoter to realize high-efficiency Li-S batteries. The porous hollow architecture not only accommodates the volume variation upon the lithiation-delithiation processes, but also exposes vast active interfaces for facilitated sulfur redox reactions. Meanwhile, the mesoporous carbon coating establishes a highly conductive network for fast electron transportation. More importantly, the defective $Fe_{3-x}C$ nanosized subunits impose strong LiPS adsorption and catalyzation, rendering a fast and durable sulfur electrochemistry. Attributed to these structural superiorities, the obtained sulfur electrodes exhibit excellent electrochemical performance, i.e., high areal capacity of 5.6 mAh cm^{-2}, rate capability up to 5 C, and stable cycling over 1000 cycles with a low capacity fading rate of 0.04 % per cycle at 1 C, demonstrating a great promise in the development of practical Li-S batteries.