High-Performance Cathode Materials for Lithium-Sulfur Batteries

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Lithium-sulfur (Li-S) batteries are considered as promising high-energy storage devices due to their outstanding energy density. However, the low electrical conductivity of sulfur, dissolution of the active material, and sluggish reaction kinetics cause poor cycle stability and rate performance. A variety of studies have been attempted to resolve the above issues and achieve improved electrochemical performance. However, inexpensive multifunctional host materials that can accommodate large amount of sulfur and exhibit high electrode density are not widely available. Herein, mesoporous carbon microspheres with ultrahigh pore volume are synthesized, followed by the incorporation of molecular catalysts into the mesopores, which can act as sulfur hosts. The ultrahigh pore volume of the prepared host material can accommodate up to ~87 wt.% sulfur while the uniformly controlled spherical morphology and particle size of the carbon microspheres enable high areal/volumetric capacity with high electrode density. Furthermore, the uniform distribution of molecular catalysts enhances the redox kinetics of conversion reaction of sulfur and efficiently immobilize the soluble intermediates.