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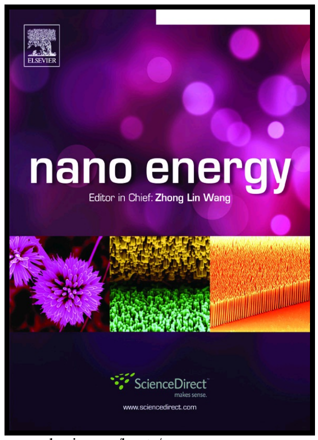

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Hierarchical Electrode Architectures for High Energy Lithium-Chalcogen Rechargeable Batteries

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Abstract

Lithium-chalcogen batteries, including lithium-sulfur (Li-S) and lithium selenium (Li-Se) systems, have been recognized as promising candidates for high energy electrical storage solution. The key challenge for lithium-chalcogen systems is to increase the chalcogen content in the system without sacrificing performance in order to compete with Li-ion batteries. Here we report a rationally designed hierarchical porous carbon (SPC) electrode architectures with maximum micro-, meso- and macro-level porosities as the conductive framework for the lithium-chalcogen batteries. The hierarchical electrode architectures enable high mass loading of the active cathode materials, encapsulation of both the small and long chain chalcogenide species, reduced SEI reaction, and efficient mass transport in the electrolyte. The ideal cathode architecture to allow a maximum conversion reaction mechanism is identified for stable cycling. Cell level calculations suggests that the hierarchical electrode architectures have the potential to increase the specific energy to more than 350 Wh kg^{-1}, much higher than what can be achieved using the materials and parameters reported in the literature.

Keywords

Batteries, Li-S, Li-Se, Porous Carbon, Lithium nitrate, Pouch Cell