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Nanostructured Materials for Portable and Stationary Energy Storage

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Storing energy electrochemically involves electronic and ionic processes and chemical transformation inside and at the interface of materials. The ability to understand and design nanostructures and their interfaces afford the great opportunities for controlling these fundamental processes, which can ultimately lead to high performance energy storage devices. Here I will present several exciting examples on designing nanostructures and their interfaces to realize high performance energy storage devices. One example is on designing nanowires and heterostructured nanowires for ultrahigh capacity storage of lithium ions in silicon anodes and sulfur cathodes. The challenges associated with large volume expansion, electron and ion transport, and solid-electrolyte-interphase (SEI) have been addressed. Another example is to design open framework structure of nanocrystals, which facilitate insertion of sodium and potassium ions. The high power, high energy efficiency and low-cost aqueous batteries can be enabled for grid scale stationary storage.