Patent Search

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Abstract:

The invention revolves around a novel lithium-ion battery enhanced with nanostructured cathode materials. By employing these advanced nanostructures, the battery offers superior energy density, rapid charge-discharge rates, and extended longevity. The innovative design and synthesis techniques employed harness the unique properties emerging at the nanoscale, leading to groundbreaking advancements in energy storage solutions suitable for a wide range of applications from portable electronics to electric vehicles and large-scale energy storage systems.

Complete Specification

Description:The present invention pertains generally to the domain of electrochemical energy storage systems, and more particularly, to the design, synthesis, and application of nanostructured cathode materials that significantly enhance the durability, capacity, and overall performance of lithium-ion batteries. This invention seeks to address the prevalent challenges in the battery industry related to longevity, energy density, and charge-discharge rates, by innovatively leveraging the unique properties that arise at the nanoscale.

Background of the invention:

The ongoing evolution and expansion of portable electronics, electric vehicles, and renewable energy storage solutions have heightened the demand for batteries with superior energy storage capacity, fast charging capabilities, and enhanced life cycles. Historically, the most prevalent energy storage device has been the lithium-ion battery, owing primarily to its relatively high energy density and its compact form factor. A critical component that dictates the performance of these batteries is the cathode material, as it plays a pivotal role in determining the energy density, charge-discharge rates, and cycle longevity of the battery.

For many years, conventional cathode materials, such as layered oxides (like $LiCoO_2$), olivines (like $LiFePO_4$), and spinels (like $LiMn_2O_4$), have been employed in commercial lithium-ion batteries. While they have served the purpose for a variety of applications, their inherent structural and electrochemical limitations have acted as bottlenecks for achieving higher energy densities and longer cycle lives. Additionally, with the increasing power requirements of emerging technologies and the necessity for rapid charging in applications like electric vehicles, there's an urgent need for cathode materials that can offer faster electron and ion transport.

With the advent of nanotechnology, researchers have observed that materials at the nanoscale often exhibit properties distinct from their bulk counterparts. These unique characteristics arise due to the increased surface area, quantum confinement effects, and shorter diffusion paths at the nanoscale. Drawing inspiration from this

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