Silicon-based energy storage materials

Lithium-ion batteries (LIBs) have been occupying the dominant position in energy storage devices. Over the past 30 years, silicon (Si)-based materials are the most promising alternatives for graphite as LIB anodes due ...

Six compositions of aluminum (Al) and silicon (Si) based materials: 87.8Al-12.2Si, 80Al-20Si, 70Al-30Si, 60Al-40Si, 45Al-40Si-15Fe, and 17Al-53Si-30Ni (atomic ratio), were investigated for potentially high thermal energy storage (TES) application from medium to high temperatures (550-1200 °C) through solid-liquid phase change.

To meet the stern requirements of emerging large-scale applications such as eco-friendly means of transportation (electromobility), integration of renewable energy sources and utility/grid, high-performance electrochemical energy storage devices are needed [1], [2].Among existing energy storage systems, lithium-ion batteries (LIBs), based on graphite (Gr) anode, ...

Rechargeable lithium-ion batteries (LIBs) have attracted widespread attention due to their high energy density, long cycle life, and environment friendliness, making them widely used in electronics and electric vehicles [[1], [2], [3]].As battery technology advances, there is an increasing demand for high-performance electrode materials to optimize battery performance ...

Fortunately, metal-organic frameworks (MOFs) have been widely attracted as emerging materials in energy storage and conversion due to their tunable properties, outstanding morphological and structural advantages. The application of MOF and its derivatives to recast the energy storage properties of silicon and its oxides anode materials is an ...

The increasing demand for higher-energy-density batteries driven by advancements in electric vehicles, hybrid electric vehicles, and portable electronic devices necessitates the development of alternative anode materials with a specific capacity beyond that of traditional graphite anodes.

For anode materials, Si is considered one of the most promising candidates for application in next-generation LIBs with high energy density due to its ultrahigh theoretical specific capacity (alloyed Li 22 Si 5 delivers a high capacity of 4200 mA h g -1, which is ~11-fold that of graphite anodes (372 mA h -1)), abundant resources (Si is the second most abundant ...

From mobile devices to the power grid, the needs for high-energy density or high-power density energy storage materials continue to grow. Materials that have at least one dimension on the nanometer scale offer opportunities for enhanced energy storage, although there are also challenges relating to, for example, stability and manufacturing.

Ummartyotin"s group has generally reviewed clay-based materials in energy storage and conversion application with the focus on the dielectric and dye sensitized solar cell applications, which will not be summarized in detail herein. ... and clay-based materials have promising application prospects. In this section, we reviewed the silicon and ...

Six compositions of aluminum (Al) and silicon (Si) based materials: 87.8Al-12.2Si, 80Al-20Si, 70Al-30Si, 60Al-40Si, 45Al-40Si-15Fe, and 17Al-53Si-30Ni ... Research on thermal energy storage of phase change materials (PCM) has been standing in the forefront of science. Several evident defects exist in the phase change materials ...

Rechargeable lithium batteries play an increasingly significant role in our daily lives. Hence, the development of high capacity secondary lithium batteries has become a research hotspot. In the past decade, silicon has been extensively studied as anode material for Li-ion batteries because of its extremely high specific capacity.

For energy-related applications such as solar cells, catalysts, thermo-electrics, lithium-ion batteries, graphene-based materials, supercapacitors, and hydrogen storage systems, nanostructured materials have been extensively studied because of their advantages of high surface to volume ratios, favorable tran

From battery capacity perspective, there is more room for improvement for anode materials as compared to cathode materials [7], [18], [19], [20].Among all the potential anode materials, silicon (Si) has been regarded as one of the most promising alternatives to commercial graphite anode due to its appealing advantages [21] rstly, Si is the second ...

The increasing broad applications require lithium-ion batteries to have a high energy density and high-rate capability, where the anode plays a critical role [13], [14], [15] and has attracted plenty of research efforts from both academic institutions and the industry. Among the many explorations, the most popular and most anticipated are silicon-based anodes and ...

Although the large latent heat of pure PCMs enables the storage of thermal energy, the cooling capacity and storage efficiency are limited by the relatively low thermal conductivity (~1 W/(m ? K)) when compared to metals (~100 W/(m ? K)). 8, 9 To achieve both high energy density and cooling capacity, PCMs having both high latent heat and high thermal ...

Silicon-based energy storage systems are emerging as promising alternatives to the traditional energy storage technologies. This review provides a comprehensive overview of the current state of research on silicon-based energy storage systems, including silicon-based batteries and supercapacitors. This article discusses the unique properties of silicon, which ...

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