

Germanium-based lithium battery



Overview

Germanium-based materials with extremely high theoretical energy capacities have gained a lot of attention recently as potential anodes for lithium ion batteries. These materials can also offer improved Li in. Lithium ion batteries (LIBs) with advanced properties, such as high energy and power. Key challenges for successful improvement of future batteries lie in achieving high energy density and capacity, excellent rate capacity, long stable cycling life, low cost, environmental fri. Germanium-based compounds, including oxides, chalcogenides, phosphides, and germanates, followed the conversion and alloying reaction mechanism. The formation of new lithium oxi. Ge alloys and their composites undergo a stepwise lithiation/delithiation process, which favors the suppression of huge volume variations and brings a moderate operating voltage. Germanium-based anode materials possess high theoretical capacity, high intrinsic electronic conductivity and fast lithium ion diffusion kinetics, making it ideal anode materials t.



Article Content

Germanium-Based Electrode Materials for Lithium-Ion ...

Lithium-ion batteries (LIBs) with superior energy density, rate capability, and cyclability are critically needed for next-generation portable electronics and electric vehicles. Germanium (Ge) is a promising candidate ...

Solution-Grown Germanium Nanowire Anodes for Lithium-Ion Batteries

Solution-grown germanium (Ge) nanowires were tested as high capacity anodes in lithium ion (Li-ion) batteries. Nanowire films were formulated and cast as slurries with ...

High-performance germanium nanowire-based lithium-ion battery ...

The formation of high-performance and high-capacity lithium-ion battery anodes from high-density germanium nanowire arrays grown directly from the current collector with excellent rate performance characteristics is reported. Here we report the formation of high-performance and high-capacity lithium-ion battery anodes from high-density germanium nanowire arrays grown ...

Germanium nanowires-based carbon composite as anodes for lithium ...

Lithium-ion batteries have been actively researched in recent years due to it being one of the most promising energy storage systems. Herein, we report a novel approach where germanium nanowires (Ge NW) are grown in gold-seeded porous carbon via the solution-liquid-solid mechanism, and the corresponding improvement observed in terms of the ...

Germanium-Based Electrode Materials for Lithium-Ion Batteries

Germanium-based.-Ge is another promising candidate electrode material to obtain high-capacity LIBs, because of its high volumetric capacity second only to Si, and its high gravimetric capacity ...

Germanium-Based Electrode Materials for Lithium-Ion Batteries

Lithium-ion batteries (LIBs) with superior energy density, rate capability, and cyclability are critically needed for next-generation portable electronics and electric vehicles. ... Dive into the research topics of "Germanium-Based Electrode Materials for Lithium-Ion Batteries". Together they form a unique fingerprint. Lithium Ion Battery ...

First-Principles Dynamics Investigation of Germanium as an ...

Germanium, a promising electrode material for high-capacity lithium ion batteries (LIBs) anodes, attracted much attention because of its large capacity and remarkably fast charge/discharge kinetics. Multivalent-ion batteries are of interest as potential alternatives to LIBs because they have a higher energy density and are less prone to safety hazards. In this study, ...

Nano germanium incorporated thin graphite nanoplatelets: A ...

Germanium-based materials are arousing increasing interest as anodes for lithium-ion batteries, stemming from the intrinsic physical and chemical advantages of germanium.

Nanoporous germanium as high-capacity lithium-ion battery anode

Investigated as anode materials for lithium-ion batteries, mesoporous germanium nanoparticles exhibit a high capacity retention, high rate capacity and high energy retention. ... with a high theoretical capacity based on alloyed lithium and germanium ($1384 \text{ mA h g}^{-1} \text{ Li}_{15}\text{Ge}_4$), has stimulated tremendous research as a promising candidate anode ...

Unique Structural Design and Strategies for ...

Germanium-based materials are arousing increasing interest as anodes for lithium-ion batteries, stemming from the intrinsic physical and ...

High-rate and low-temperature performance of germanium nanowires anode ...

High-performance germanium nanowire-based lithium-ion battery anodes extending over 1000 cycles through in situ formation of a continuous porous network. Nano Lett. (2014) M. Aghazadeh Meshgi et al. Rapid, low-temperature synthesis of germanium nanowires from oligosilylgermane precursors.

Unique Structural Design and Strategies for ...

Herein, we have presented recent progress on the development of germanium-based materials for lithium-ion batteries. Table 1 summarized the electrochemical performance of germanium-based materials. The most serious ...

A New Germanium-Based Anode Material with High ...

The anode materials based on conversion or alloying reaction typically show a large specific capacity and suitable working potential in lithium-ion batteries (LIBs). However, the large volume change and relatively low ionic/electronic ...

Opportunities and challenges of nano Si/C composites in lithium ...

Nano germanium incorporated thin graphite nanoplatelets: A novel germanium based lithium-ion battery anode with enhanced electrochemical performance. Electrochim. Acta (2021) ... Recent progress and future perspective on practical silicon anode-based lithium ion batteries. Energy Storage Materials, Volume 46, 2022, pp. 482-502.

Ti₃C₂T_x MXene coated 3D ordered macroporous germanium

Unique structural design and strategies for germanium-based anode materials toward enhanced lithium storage. ... Germanium nanotubes prepared by using the kirkendall effect as anodes for high-rate lithium batteries. *Angew. Chem. Int. Ed.*, 50 (2011), pp. 9647-9650.

Germanium-Based Electrode Materials for Lithium-Ion Batteries

Advanced energy-storage systems are critically important for meeting the ever-increasing demand for applications from portable electronics to all-electric vehicles, and recently for applications in the grid for storing energy from fluctuating renewable sources, such as wind or solar energy. Lithium-ion batteries (LIBs) have received worldwide attention as a top ...

Germanium in Lithium-Ion and Sodium-Ion Batteries (A Review)

In recent decade, special interest is paid to germanium as potential material of negative electrodes in lithium-ion and, the more so, sodium-ion batteries. In the review, studies ...

High-Performance Lithium Storage Achieved by Chemically ...

Germanium (Ge) is a promising anode material for lithium ion batteries due to its high theoretical capacity. However, its poor cycling stability associated with its large volume changes during discharging and charging processes are urgent problems to solve. This provides opportunities to engineer materials to overcome these issues. Here, we demonstrated a facile ...

Electrochemical Behavior of Reduced Graphene Oxide Supported Germanium ...

Germanium and germanium-based compounds are widely used in microelectronics, optics, solar cells, and sensors. Recently, germanium and its oxides, nitrides, and phosphides have been studied as active electrode materials in lithium- and sodium-ion battery anodes. Herein, the newly introduced highly soluble germanium oxide (HSGO) was ...

Toward High-performance Lithium-ion Batteries via A New Germanium-based ...

In comparison to traditional and single metal oxides, multielement metal oxides exhibit enhanced specific capacity, buffer the volume expansion, and facilitate charge transfer or ion diffusion, which are regarded as promising anode materials for lithium-ion batteries (LIBs). Herein, we present a new carbon coating multielement metal oxide calcium titanium germanate ...

Nano germanium incorporated thin graphite nanoplatelets: A ...

This work delivers a robust electrode design strategy as well as the most practical route for the improvement of germanium-based anodes for application in lithium-ion batteries. Introduction Recently, silicon (Si), germanium (Ge) and tin (Sn) are recognised as high performance lithium-ion battery (LIB) anodes due to their much higher ...

Binder-free nanostructured germanium anode for high resilience lithium ...

The development and the characterization of a nanostructured binder-free anode for lithium-ion batteries exploiting the germanium high theoretical specific capacity (1624 mAh g⁻¹ for Li₂₂Ge₅ alloy) is herein presented. This anode secures remarkable performances in different working conditions attaining a 95% capacity retention at 1C (i.e., 1624 mA g⁻¹) ...

Toward High-performance Lithium-ion Batteries via A New ...

In comparison to traditional and single metal oxides, multielement metal oxides exhibit enhanced specific capacity, buffer the volume expansion, and facilitate charge transfer ...

Construction and modification of germanium-based anode ...

Lithium-ion batteries have been widely used in portable electronic devices and electric vehicles due to their high energy density, long cycle life, an...

Multidimensional Germanium-Based Materials as Anodes for Lithium...

Metallic germanium is an ideal anode for lithium-ion batteries (LIBs), owing to its high theoretical capacity (1624 mA h g⁻¹) and low operating voltage. Herein, we highlight recent advances in the development of Ge-based anodes in LIBs, although improvements in their coulombic efficiency (CE), capacity retention, and rate performance are still required.

Solution-Grown Germanium Nanowire Anodes for Lithium-Ion Batteries

Solution-grown germanium (Ge) nanowires were tested as high capacity anodes in lithium ion (Li-ion) batteries. Nanowire films were formulated and cast as slurries with conductive carbon (7:1 Ge:C w/w), PVdF binder and 1.0 M LiPF₆ dissolved in various solvents as electrolyte. The addition of fluorethylene carbonate (FEC) to the electrolyte was critical to ...

Construction and modification of germanium-based anode ...

This paper summarizes the research progress of germanium-based anode material modification in lithium-ion batteries, including its preparation technology means, ...

Advances of lithium-ion batteries anode materials—A review

The process of lithiation and a comprehensive analysis of the electrochemical performance of anodes based on germanium have not received sufficient attention or thorough exploration. This review provides a complete and up-to-date examination of the recent developments in germanium-based anodes utilized in lithium-ion batteries.

High-Performance Germanium Nanowire-Based Lithium-Ion Battery ...

High-Performance Germanium Nanowire-Based Lithium-Ion Battery Anodes Extending over 1000 Cycles Through in Situ Formation of a Continuous Porous Network. January 2014; Nano Letters 14(2)

Recent progress on germanium-based anodes for lithium ion batteries ...

However, the low specific theoretical capacity of graphite limits the energy density of the commercial LIBs . Germanium, as a lithium alloying material, is a possible alternative ...

Germanium based glass modified by graphene as anode material ...

Request PDF | On Dec 1, 2024, Siguang Feng and others published Germanium based glass modified by graphene as anode material with high capacity for lithium-ion batteries | Find, read and cite all ...

Understanding Phase Transformation in Crystalline Ge Anodes ...

Lithium-ion batteries using germanium as the anode material are attracting attention because of their high-capacity, higher conductivity, and lithium-ion diffusivity relative to silicon. Despite recent studies on Ge electrode reactions, there is still limited understanding of the reaction mechanisms governing crystalline Ge and the transformations into intermediate ...

Germanium-graphene composite anode for high-energy lithium batteries ...

The high-energy lithium ion battery is an ideal power source for electric vehicles and grid-scale energy storage applications. Germanium is a promising anode material for lithium ion batteries due to its high specific capacity, but still suffers from poor cyclability. ... sulfur, phosphorus) for the preparation of graphene-based composites for ...

Solution-Grown Germanium Nanowire Anodes for ...

Solution-grown germanium (Ge) nanowires were tested as high capacity anodes in lithium ion (Li-ion) batteries. Nanowire films were formulated and cast as slurries with conductive carbon (7:1 Ge:C w/w), PVdF binder and ...

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Metallic germanium is an ideal anode for lithium-ion batteries (LIBs), owing to its high theoretical capacity (1624 mA h g⁻¹) and low operating voltage.

A Chronicle Review of Nonsilicon (Sn, Sb, Ge)-Based Lithium...

Since the commercialization of lithium-ion batteries (LIBs) in the early 1990s, tin (Sn), antimony (Sb), and germanium (Ge)-based anodes have attracted considerable research interest as promising candidates for next-generation LIBs due to their high theoretical capacities, suitable operating voltages, and natural abundance.

Nano germanium incorporated thin graphite nanoplatelets: A ...

First-principles calculations forecast that germanium incorporated graphite has potential to be used as high performance negative electrode for lithium-ion batteries due to ...

High-rate and low-temperature performance of germanium nanowires ...

High-performance germanium nanowire-based lithium-ion battery anodes extending over 1000 cycles through in situ formation of a continuous porous network. Nano Lett., 14 (2) (2014), pp. 716-723, 10.1021/nl403979s. View in Scopus Google Scholar

Germanium-Based Electrode Materials for Lithium-Ion Batteries

Novel phenomena are uncovered in germanium-based electrode materials by using this technique. Abstract. Lithium-ion batteries (LIBs) with superior energy density, rate capability, and cyclability are critically needed for next-generation portable electronics and electric vehicles. Germanium (Ge) is a promising candidate material for the high ...

Multidimensional Germanium-Based Materials as Anodes for Lithium ...

This Focus Review highlights recent advances in the development of Ge-based anodes in LIBs, although improvements in their coulombic efficiency, capacity retention, and rate performance are still required. Metallic germanium is an ideal anode for lithium-ion batteries (LIBs), owing to its high theoretical capacity (1624 mA h g⁻¹) and low operating voltage.

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Here we report the formation of high-performance and high-capacity lithium-ion battery anodes from high-density germanium nanowire arrays grown directly from the current collector. The anodes retain capacities of ~900 ...

High-performance germanium nanowire-based lithium-ion battery ...

Here we report the formation of high-performance and high-capacity lithium-ion battery anodes from high-density germanium nanowire arrays grown directly from the current collector. The anodes retain capacities of ~ 900 mAh/g after 1100 cycles with excellent rate performance characteristics, even at ...

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