Germanium and high energy storage lithium battery

Is germanium a good anode material for lithium ion batteries?
Germanium (Ge) is a promising anode materialfor 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.

How can germanium materials improve the electrochemical performance of a battery?
The preparation of germanium materials into nanoparticles ,,nanowires ,,nanotubes ,,or nanofilms structures can significantly increase their specific surface area and lithium ion diffusion rate,thus improving the electrochemical performance of the battery.

Could germanium-based anodes meet the increasing requirements for batteries?
It is believed that germanium-based anodes could meet the increasing requirementsfor batteries with high power and energy densities. The histogram of the number of publications reflects the increased interest in germanium-based anodes in general during the last decade (Fig. 1).

What are the advantages of germanium based materials?
In addition to the high theoretical capacity,germanium-based materials have many other obvious advantages. 1) High lithium-ion diffusivity. Ge is 400 times faster in lithium ion diffusion than Si (at room temperature,1.41 × 10 -14 cm 2 s -1 for Si and 6.51 × 10 -12 cm 2 s -1 for Ge ; at 150 °C,3.1 × 10 -9 cm 2 s -1 for Ge) .

Are germanium-based anodes suitable for lithiation?
Germanium-based materials for LIBs have been demonstrated to possess ultrafast charge-discharge rate, high stability and robustness after lithiation. Several reviews focused on germanium-based anodes have been published recently [, , , , ,].

What are lithium ion batteries?
1. Introduction Lithium ion batteries (LIBs) with advanced properties, such as high energy and power densities, low cost, and long cycling span, have received tremendous consideration in the past decade [1, 2]. Nowadays, LIBs have been successfully used in portable electronic devices, power tools and electric vehicles.

As the mainstream of chemical energy storage, secondary batteries [3] have received great attention. Lead-acid batteries [4] were first used in vehicle starting batteries and electric motorcycles due to their low cost and high stability, but its low energy density and lead pollution are issues that cannot be forgotten. Ni-Cd batteries are secondary batteries originally ...

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Recently, silicon (Si), germanium (Ge) and tin (Sn) are recognised as high performance lithium-ion battery (LIB) anodes due to their much higher theoretical capacities of 4200,1600 and 990 mAh g -1, respectively [1, 2].Although Si is demonstrated as an attractive anode candidate, however, Ge possesses unique advantages over Si anode including high ...

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 ...

With the rapid evolution of electronic devices and the emergence of new energy vehicles, the demand for lithium-ion batteries (LIBs) with enhanced overall performance has significantly increased [1], [2], [3].Exploring anode materials exhibiting high energy density, prolonged cycle life, and adaptability to varying temperatures has become a prominent area of ...

Rechargeable batteries play a critical role in many energy storage systems that support renewable energy sources and the sustainability of the environment [[1], [2], [3]]. The emerging of consumer electronics and electric vehicle fields require rechargeable Li-ion batteries with high energy and the ability to charge/discharge quickly.

Nanoporous germanium (np-Ge) was firstly prepared by chemical dealloying. The scalable technique allows for mass production of electrodes for LIBs. Nanoporous structure ...

Lithium ion batteries (LIBs) have dominated the energy storage field for decades due to their high energy density and long cycle life, especially in mobile device applications. With the increasing deployment of electric vehicles (EVs) and proliferation of handheld devices that use LIBs, the need to improve LIB technology has become essential [1 ...

This rapid transition will only be possible with the continual improvement of energy storage systems. The demand for lithium-ion batteries is set to exponentially increase in other segments as ...

Thermal annealing of the nanowire fabric in a reducing environment converts the polyphenylsilane coating to a carbonaceous layer that significantly increases the electrical conductivity of the material. This makes the nanowire fabric useful as a self-supporting, mechanically flexible, high-energy-storage anode material in a lithium ion battery.

Matching the irreversible capacity loss of high capacity anodes and cathodes is demonstrated as a viable strategy for achieving enhanced gravimetric energy density lithium ion batteries. Germanium ...

He will receive his master?s degree from School of Materials Science & Engineering, Shandong University, China in June 2016. He has been working in Professor Xiufang Bian?s laboratory since July 2013. His current research focuses on nanoporous structure/Ni-P film for energy conversion and storage, lithium-ion batteries.

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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 ...

The lithium-ion battery (LIB) is an essential secondary battery system for portable electronic devices, electric vehicles (EVs), hybrid EVs, and energy storage system thanks to its high energy density and output voltage [[1], [2], [3]] cause of limited Li reserves and the high cost of Li, many researchers are investigating new secondary battery systems as an ...

Lithium-ion batteries (LIBs) are ones of the most promising energy storage devices in the field of electric vehicles (EVs), portable electronics, and smart grids because of their high energy and power densities [1]. Moreover, they also have attracted tremendous interest as the back-up generating capacity to supplement intermittent renewable ...

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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 ...

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 ...

Bottom-up synthesis of mesoporous germanium as anodes for lithium-ion batteries. Author links open overlay panel Duihai Tang a, Huan Yu a, Jiawei Zhao b, ... Cost-effective scalable synthesis of mesoporous germanium particles via a redox-transmetalation reaction for high-performance energy storage devices. ACS Nano, 9 (2015), pp. 2203-2212.

By limiting the voltage cutoff window in an appropriate range, the obtained Ge anode exhibits excellent lithium storage performance in half- and full-cells, which can be mainly attributed to the designed nanostructured current collector with good conductivity, enough buffering space for the volume change, and shortened ionic transport length. Germanium is a ...

Since their commercialization in the 1990s, lithium-ion batteries (LIBs) have dominated energy storage application [1-5]. Show abstract Despite numerous studies investigating Fe 3 O 4 /porous carbon anode materials for high-performance lithium-ion batteries (LIBs), the inherent limitations of the Fe 3 O 4

conversion reaction, such as low ...

The as-prepared NiO@C-N NSs electrode exhibited high-room-temperature Li storage capacity (1036 mAh g - 1 at 0.05 A g - 1) together with good low-temperature Li storage performance (428 mAh g - 1 at 0.05 A g - 1 under -40 °C) (Fig. 3 d). Although non-graphite-based carbon materials demonstrate excellent performance in low-temperature ...

The development of more sustainable energy storage and conversion technologies is essential due to the gradual depletion of fossil fuels and the resultant environmental harm [1].One of the main energy storage technologies, lithium ion batteries (LIBs), currently dominate the commercial sector [2].The evolution of electronic devices powered by lithium-ion batteries ...

Lithium-ion batteries have become a promising energy storage device and power source, but the organic liquid electrolyte used in traditional lithium-ion batteries has a series of serious security risks such as decomposition, leakage, spontaneous combustion, and even explosion. ... sulfur-silver-germanium ore type [59], and Li 10 GeP 2 S 12 type ...

Germanium-based anode materials have emerged as a key focus of research in the realm of lithium-ion batteries, owing to their high theoretical specific capacity (about 4 ...

Lithium-ion batteries (LIBs) are the main power source for portable electronic devices due to its high energy/power density and cycle stability. To date, a great deal of effort has been expended to improve LIBs with higher electrochemical performance to meet the growing demands for electronic equipment and hybrid electric cars [[1], [2], [3]].

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 ...

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