

Is red phosphorus a good anode material for potassium ion storage?

This mini-review focuses on the recent progress on development of red phosphorus anode materials for highly-efficient potassium ion storage. The review is started with a short introduction to expound why red phosphorus is a valuable and promising anode material for KIBs.

Is red phosphorus a good anode for sodium ion batteries?

Red phosphorus is considered as a high capacity anode for sodium-ion batteries with a theoretical capacity of 2596 mAh/g. However, similar to silicon in lithium-ion batteries, several limitations, such as large volume expansion upon sodiation/desodiation and low electronic conductance, have severely limited the performance of red phosphorus anodes.

Can phosphorus be used in energy storage?

Phosphorus in energy storage has received widespread attention in recent years. Both the high specific capacity and ion mobility of phosphorus may lead to a breakthrough in energy storage materials. Black phosphorus, an allotrope of phosphorus, has a sheet-like structure similar to graphite.

What is red phosphorus (RP)?

Red phosphorus (RP), featured with outstanding stability and facile preparation process, is of particular interest [4,5]. It allows for the insertion of 3 Li⁺/Na⁺ ions at ~0.7/0.4 V (vs. Li⁺/Li or Na⁺/Na) that results in a high theoretical capacity of 2,596 mA h g⁻¹ [6,7].

Can amorphous red phosphorus be used as an anode for lithium ion batteries?

Yuan, D. et al. Amorphous red phosphorous embedded in carbon nanotubes scaffold as promising anode materials for lithium-ion batteries. *J. Power Sources* 301, 131-137 (2016). Wang, Y. et al. Enhanced reversibility of red phosphorus/active carbon composite as anode for lithium ion batteries. *Electrochim. Acta* 163, 71-76 (2015).

Can black phosphorus be used in energy storage?

In this review, we outline recent research on the application of black phosphorus in energy storage. By the summary of several early reviews and the collation of related research fields, the important research progress of phosphorus, especially black phosphorus, in the field of electrochemistry is introduced.

The possibility of using red phosphorus as the functional material in sodium-ion batteries was first reported in 2013 [1]. Its authors demonstrated that it is possible to reach the reversible capacity on sodium intercalation of about 1900 mA h/g in the S/20 current mode (143 mA/g) at not too high degradation rate (0.2% per cycle) and also outlined the main problems ...

Although sodium ion batteries (SIBs) are one of the most promising battery technologies, their relatively low

energy density impedes further development. This study presents the novel practical application potential of high-capacity red phosphorus (P) in full SIBs with reasonable energy density. Various optimization strategies are implemented systematically, ...

Earth-abundant stable elemental semiconductor red phosphorus-based hybrids for environmental remediation and energy storage applications ... Therefore, several studies have focused on elemental semiconductor photocatalysts such as red phosphorus (RP) because of its narrow band gap, high absorption ability for the incident solar spectrum, low ...

Potassium ion batteries (PIBs) are a viable alternative to lithium-ion batteries for energy storage. Red phosphorus (RP) has attracted a great deal of interest as an anode for ...

Black phosphorus-based materials for energy storage and electrocatalytic applications, Xiong-Xiong Xue, Haiyu Meng, Zongyu Huang, Yexin Feng, Xiang Qi. Skip to content ... It is noted that BP is the most stable and least reactive form compared to ...

To further improve the electrochemical performance of phosphorus, Qian et al. prepared an amorphous phosphorus/carbon nanocomposite (a-P/C) through ball-milling red phosphorus with conductive carbon black powders and found that the amorphous phosphorus can fully store reversible 3-Li storage capacity (2355 mA h/g) with stable cyclability (2119. ...

The process for the fabrication of the P/C composite, featuring ultrafine red P particles (~10 nm) embedded in 3D carbon matrix, is schematically depicted in Fig. 1 rstly, white P 4 O 10 particles were coated with a polymer shell of PEG in a vacuum oven at 80 °C (Fig. 1 a). Tens of minutes later (Fig. 1 b), the mixture turned black due to dehydration and ...

Introduction. With the rapid progress of global economics and society, advanced energy storage technologies are getting more important for human's daily life.[1], [2], [3] Lithium-ion batteries (LIBs) have been applied in a wide range of electronics because of the relatively high energy density compared to the conventional energy storage systems.

utilization of batteries. Red phosphorus also has high theoretical specific capacity, similar to BP, but red phosphorus is non-conducting so that it cannot be used directly for energy storage. Distinct from red phosphorus, BP or phosphorene is a fairly good conductor of electricity, which exhibits mobility on the order of $\sim 1000 \text{ cm}^2/\text{V}\cdot\text{s}$ [19,46 ...

Supercapacitors have received notable attention among various energy storage devices due to their high power density, extended cycle life and low cost [2], ... 3 g of red phosphorus was dispersed in 100 mL NMP, followed by stirring and sonication in a bath sonicator. Black phosphorus with some red phosphorous (RBP hybrid) was produced under ...

Lithium ion batteries (LIBs) have been widely studied as a means of obtaining more efficient energy storage systems due to their high energy density, minimal self-discharge features and stable cycling performance [1, 2]. However, the commercial graphite-based anode with a low specific capacity (372 mAh g^{-1}) and low lithiation potential ($0.1 \text{ V vs Li}^+/\text{Li}$) is ...

Download scientific diagram | Crystal structures of white phosphorus, red phosphorus, and black phosphorus (2). Reprinted from reference (2). Liu, W.; Zhi, H.; Yu, X. Recent progress in phosphorus ...

The preparation of phosphorus/carbon (PC) composites is a promising strategy to enhance the stability of the P anode, as the introduction of carbon improves the conductivity of P, and also acts as a skeleton to buffer its volume expansion [16, 17]. Advanced synthesis methods for PC composites mainly include high-energy ball milling (HEBM), evaporation condensation ...

Red phosphorus is a relatively stable allotrope of phosphorus with an amorphous polymeric networks-like structure [10]. ... high-crystalline products. Furthermore, we outline recent advancements in utilizing BP for transistors, photodetectors, energy storage and conversion, as well as biomedicine and biosensing applications. In conclusion, we ...

Phase transformation and the Gibbs free theory indicate that the generation of BP from red phosphorus is a spontaneous process ($\Delta G = -16.37 \text{ kJ mol}^{-1} < 0$). 47 In their study, red phosphorus microspheres were selected as raw material, and NH_4F was utilized to reduce the surface activation energy of the raw material. Although the bottom-up ...

More recently, phosphorus (P) allotropes have garnered increasing interest as a promising anode candidate for both LIBs and SIBs owing to their high theoretical capacity, suitable low redox potential, abundant resources, low costs, and environmental friendliness [1]. Red phosphorus (RP), featured with outstanding stability and facile preparation process, is of ...

Photocatalysis is a perennial solution that promises to resolve deep-rooted challenges related to environmental pollution and energy deficit through harvesting the inexhaustible and renewable solar energy. To date, a cornucopia of photocatalytic materials has been investigated with the research wave presently steered by the development of novel, ...

Potassium ion batteries (PIBs) are a viable alternative to lithium-ion batteries for energy storage. Red phosphorus (RP) has attracted a great deal of interest as an anode for PIBs owing to its cheapness, ideal electrode potential, and high theoretical specific capacity. However, the direct preparation of phosphorus-carbon composites usually results in exposure of the RP ...

Red phosphorus (RP) is a promising anode material for use in lithium-ion batteries (LIBs) due to its high theoretical specific capacity (2596 mA h g^{-1}). However, the practical use of RP-based anodes has been challenged by the material's low intrinsic electrical conductivity and poor structural stability during lithiation.

Here, we describe a phosphorus ...

Besides, the reaction mechanisms of red and black phosphorus in energy storage field are discussed in detail, respectively. On account of their respective advantages and disadvantages, the targeted designs of phosphorus-carbon hybrids are summarized to improve the performance of the two kinds of phosphorus. According to the interfacial contact ...

BP, which is among the most promising 2D materials, is a potential next-generation material for energy storage [33] pared with other 2D materials such as MoS₂ and MXenes, BP exhibits several advantages with respect to rechargeable batteries and supercapacitors: (i) BP exhibits an extremely high theoretical capacity (e.g., 2596 mAh g⁻¹ ...

In the most common electrolyte of 1 M LiPF₆ in ethylene carbonate/diethyl carbonate (EC/DEC, v/v = 1/1), the dissolution behavior of black phosphorus (Supplementary Section 1.1, "Preparation of black phosphorus") was studied by assembling a visual cell for direct observation. When it was discharged for the first cycle, the solution became inconspicuous ...

Secondary batteries are widely used in energy storage equipment. To obtain high-performance batteries, the development and utilization of electrode materials with cheap price and ideal theoretical gravimetric and volumetric specific capacities have become particularly important. Naturally abundant and low-cost red phosphorus ...

In this paper, red phosphorus nanoparticles (~ 97.7 nm, 51 wt% content) homogeneously embedded in porous nitrogen-doped carbon nanofibers (denoted as P@C) are prepared using a feasible electrospinning technique for the first time. Meanwhile, red P@C with the character of free-standing membrane is directly used as binder- and current collector-free ...

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Although sodium ion batteries (SIBs) are one of the most promising battery technologies, their relatively low energy density impedes further development. This study presents the novel practical application potential of high-capacity red phosphorus (P) in full SIBs with reasonable energy density. Various optimization strategies are implemented systematically, which include the ball ...

Energy Storage 2D Black Phosphorus for Energy Storage and Thermoelectric Applications Yu Zhang, Yun Zheng, Kun Rui, Huey Hoon Hng, Kedar Hippalgaonkar, Jianwei Xu, ... phorus to red phosphorus ...

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