Energy storage mechanism of black phosphorus

Can black phosphorus be used for energy storage?
Black phosphorus is a potential candidate material for next-generation energy storage devicesand has attracted tremendous interest because of its advantageous structural and electrochemical properties,including its large theoretical capacity,high carrier mobility,and low redox potential.

What are the applications of black phosphorus?
This review specifically highlights the very recent progress in the synthesis and applications of black phosphorus in the energy process,including secondary battery system,supercapacitor device,and catalysis reaction.

Could black phosphorus open a new chapter for energy materials?
All in all,with persistent attempts by researchers around the world,it is out of questionthat black phosphorus would not only open a new chapter for a new generation of energy materials but also provide a remarkable market potential in the foreseeable future. There are no conflicts to declare.

Is black phosphorus a multifunctional candidate for energy storage and conversion?
The present critical issues, challenges, and perspectives in terms of well-harnessed scalability, quality, and stability are comprehensively covered. An in-depth understanding of these aspects is of great importance for the design of black phosphorus as a multifunctional candidate in future energy storage and conversion. 1. Introduction

What is black phosphorus (BP) rediscovered as a 2D layered material?
His current research focuses on design and synthesis of nanostructured materials for electrochemical energy storage and conversion including batteries, supercapacitors, and fuel cells. Abstract Black phosphorus (BP) is rediscovered as a 2D layered material.

How does black phosphorous work?
In fact,recent X-ray diffraction experiments have proposed that black phosphorous operates through an alloy-dealloy mechanism with K ionsand the final product of electrochemical transformation is a KP (not K 3 P) alloy,which makes good cycling stability for the electrodes in PIBs [13].

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. ...

Recent preparation of black phosphorene and subsequent discovery of its excellent optical and electronic

properties have attracted great attention, and renewed interest to phosphorus. Recent researches have indicated that phosphorus structures are promising anodes for lithium-ion and sodium-ion batteries. A high theoretical capacity of 2,596 mAh·g-1 was ...

Black phosphorus (BP) is rediscovered as a 2D layered material. Since its first isolation in 2014, 2D BP has triggered tremendous interest in the fields of condensed matter physics, chemistry, and materials science. ... Nevertheless, 2D BP is considered an electrochemically active material for the energy storage mechanism (Figure 15), ranging ...

The facile low-temperature synthesis of BP by the ethylene diamine-assisted liquid phase process will facilitate the extended application of BP in energy storage and conversion field. As a thermodynamically stable semiconductor material, black phosphorus (BP) has potential application in field of energy storage and conversion. The preparation of black phosphorus is ...

Black phosphorus has been applied for potassium ion storage due to its high electronic conductivity (102 S m -1) and very stable thermodynamics due to its layered crystal structure.[21, 22] For instance, Sultana et al. firstly used black phosphorus in KIBs in 2017 with inferior electrochemical performance.[23]

Recent advances on black phosphorus for energy storage, catalysis, and sensor applications. ... Growth mechanism of black phosphorus synthesized by different ball milling techniques. J. Alloys Compd., 784 (2019), pp. 339-346. View PDF View article View in Scopus Google Scholar [24]

Black phosphorus (BP) is a thermodynamically stable two-dimensional semiconductor material, and its applications in the fields of optoelectronic devices [1], biomedicine [2], catalysis [3] and energy storage [4], [5], [6] have attracted more and more attention. Three phase structures of BP have been found: cubic, orthorhombic, rhombohedral.

The successful isolation of phosphorene (atomic layer thick black phosphorus) in 2014 has currently aroused the interest of 2D material researchers. In this review, first, the fundamentals of phosphorus allotropes, phosphorene, and black phosphorus, are briefly introduced, along with their structures, properties, and synthesis methods.

In the field of energy storage, supercapacitors are another important energy-storage device with attractive advantages, such as high-power density, ultrafast charging/discharging rate and longer cycle life as compared to other conventional energy-storage systems [3, 4]. According to ...

Two-dimensional (2D) crystals have emerged as a class of materials that can impact future electronics (Li et al., 2014), with excellent electrochemical properties and a high specific surface area, which are important for sensing, catalysis, and energy storage applications (Coleman et al., 2011).As a 2D material, graphene has many potential applications in ...

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Abstract Black phosphorus (BP), an emerging 2D material semiconductor material, exhibits unique properties and promising application prospects for photo/electrocatalysis. ... which are in favor of excellent applications in solar energy storage, ... These mechanisms correspond to the aforementioned advantageous properties of BP, reflecting its ...

Phase-Changing Microcapsules Incorporated with Black Phosphorus for Efficient Solar Energy Storage. Hao Huang, Hao Huang. Shenzhen Engineering Center for the Fabrication of Two-Dimensional Atomic Crystals, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, 518055 P. R. China ... Solar energy storage ...

In addition, the electrochemical properties and storage mechanism of phosphorene-based electrodes for rechargeable batteries and supercapacitors are discussed. Finally, the challenges and opportunities of phosphorene nanosheets in terms of exfoliation and energy storage applications are addressed.

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.

Layered black phosphorus (BP) exhibits several attractive features for high-rate, high-capacity Li storage. Through a three-electron alloying reaction with Li +, BP can theoretically deliver a gravimetric capacity of 2596 mA·hour g -1 (7, 8), which is only bettered by Si (4200 mA·hour g -1) and Li metal (3860 mA·hour g -1) ().The large capacity of BP helps offset its ...

Black phosphorous (BP) is a novel composite material. Its carrier mobility can reach more than 1000 cm2·V-1·s-1 and has a direct bandgap adjustable from 0.3 to 1.5 eV with thickness, so its photovoltaic performance is good. These properties show great potential for applications in many fields, such as energy storage, sensors, biomedicine, and environmental ...

DOI: 10.1016/J.JALLCOM.2019.01.023 Corpus ID: 140050874; Growth mechanism of black phosphorus synthesized by different ball milling techniques @article{Zhou2019GrowthMO, title={Growth mechanism of black phosphorus synthesized by different ball milling techniques}, author={Fengchen Zhou and Liuzhang Ouyang and Meiqin Zeng and Jiangwen Liu and Hui ...

Elemental black phosphorus (BP) is an attractive anode material for lithium-ion batteries (LIBs) as like other known alloying materials such as Ge, Si, Sn, Pb, As and Sb, BP offers much higher volumetric and gravimetric energy densities than traditional graphite. This is because BP charge storage benefits from the intercalation of alkali ions and their alloying with ...

Two-dimensional black phosphorus (2D BP), well known as phosphorene, has triggered tremendous attention

since the first discovery in 2014. The unique puckered monolayer structure endows 2D BP intriguing properties, which facilitate its potential applications in various fields, such as catalyst, energy storage, sensor, etc. Owing to the large surface area, good ...

Sodium-ion batteries (SIBs) have been considered as promising candidates for large-scale energy storage. ... the as-synthesized MoS 2 /black phosphorus heterostructure shows a high reversible capacity of 435.5 mA h g -1 at 1.0 A g -1 over 150 cycles and a good ... the sodium storage mechanism can be unraveled. When coupled with the high ...

Hybridization with other smaller lateral-size two-dimensional (2D) materials has been demonstrated to be effective for MXene materials in other types of energy storage devices. For instance, black phosphorus (BP) is an emerging 2D material that has been doped with MXenes for use in supercapacitors, Li-ion storage, K-ion capacitors, and Na-ion ...

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