Application of black phosphorus in energy storage

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.

What is black phosphorus?
Black phosphorus (BP) is a type of relatively novel and promising material with some outstanding properties,such as its theoretical specific capacity (2596 mAh/g) being approximately seven times larger than that of graphite as a negative material for batteries. Phosphorene,a one-layer or several-layer BP,is a type of two-dimensional material.

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.

Are black phosphorus quantum dots suitable for energy conversion and storage?
Among of them, there are existing some review articles about preparation and applications of BP flakes and black phosphorus quantum dots (BPQDs) , , , but few concentrates on their energy applications fully covering energy conversion and storage.

What is the specific capacity of black phosphorus?
In particular,black phosphorus has a folded structure,and each P atom can react with three Li or Na atoms to form Li 3 P and Na 3 P,giving it a very high theoretical specific capacity of 2596 mAh/g,which is far more than the graphite negative electrode (372 mAh/g) with its excellent energy storage properties.

Can black phosphorus be used as a negative material?
Over the past decade,black and red phosphorus have received growing interest because of their potential as high-performance negative materials in batteries[91,92,93]. Mayo et al. presented a study of LiP systems in the lithiation/sodiation process using an ab initio random structure searching (AIRSS) and atomic species swapping methods.

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, ...

However, there are few studies which aim at detailedly reviewing the application of BP and phosphorene for energy storage. In the next sections, research progress with BP ...

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In this book experts present the fundamentals, synthesis, properties and applications of the novel semiconductor 2D material black phosphorous. It discusses state-of-the-art studies, industrial ...

Black phosphorus with a long history of B100 years has recently attracted extraordinary attention and has become a promising candidate for energy storage and conversion owing to its unique ...

Recently, a new two-dimensional material, single- or few-layered black phosphorus (BP), has attracted considerable attention for applications in electronics, optoelectronics, and batteries ...

This article reviews recent advances in the application of Black Phosphorus for energy storage, highlighting its potential, challenges, and future prospects.

On the basis of the current progress, a few personal perspectives on the existing challenges and future research directions in this developing field are provided. Keywords: 2D ...

Moving on to energy applications, BP is used in batteries, supercapacitors, and hydrogen generation, where its unique electrical and structural properties improve energy ...

Abstract Black magic: Recent advances in black phosphorus applications in energy conversion and storage are comprehensively reviewed. Black ...

Black phosphorus with a long history of ~100 years has recently attracted extraordinary attention and has become a promising candidate for energy storage and conversion owing to its unique ...

Recently, a new two-dimensional material, single- or few-layered black phosphorus (BP), has attracted considerable attention for applications in ...

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 ...

With the rapid development of flexible functional electronics (e.g., flexible display, electronic skin and intelligent wearable device), flexible supercapacitors (FSCs) have ...

Applications of Phosphorene and Black Phosphorus in Energy Conversion and Storage Devices Jinbo Pang, Alicja Bachmatiuk, Yin Yin, Barbara Trzebicka, Liang Zhao, Lei Fu, Rafael G. ...

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The latest recent advances of BP-based functional materials in energy storage applications including lithium-, magnesium- and sodium-ion ...

Black phosphorus (BP), a two-dimensional material with a puckered honeycomb structure, has attracted significant interest for its distinctive electronic, optical, and thermal ...

Phosphorene and phosphorene-based materials receive extensive attention for potential applications in energy storage and conversion devices. In this Review, the state-of ...

Abstract The successful isolation of phosphorene (atomic layer thick black phosphorus) in 2014 has currently aroused the interest of 2D material ...

BP, phosphorene or their composite materials can significantly improve the performance of energy storage devices, e.g., mainly lithium ion batteries, sodium ion batteries and supercapacitors. ...

Especially, in the application of lithium battery, black phosphorus has more obvious advantages. Graphene as a conventional material, owning the theoretical specific ...

Black phosphorus (BP) is a unique two-dimensional material with excellent conductivity, and a widely tunable bandgap. In recent years, its ...

Two-dimensional black phosphorus (TDBP) is desirable for electrical devices due to its adjustable direct band gap (0.3 to 2.0 eV), high mobility of carriers (~1000 cm 2 V -1 s ...

Two-dimensional black phosphorus (2D BP) possesses huge potential in electrochemical energy storage field owing to its unique electronic ...

In this review, we provide a broad overview of recent investigations on the applications of red and black phosphorus in energy storage. Several early reviews have ...

As a new type of 2D semiconductor, black phosphorus (BP) possesses high charge-carrier mobility and theoretical capacity, thickness-dependent bandgap, and anisotropic structure, ...

Due to its electrical conductivity and high hole mobility, the application of black phosphorus in energy conversion/storage devices, including batteries, supercapacitors, and ...

Black phosphorus has potential for a wide range of applications in electronics and optoelectronics, including photodetectors, supercapacitors, superconductors, ...

Significant progress has been made in the scientific research and application of phosphorus allotrope and its

composites. BPNSs have a wide ...

ABSTRACT Black phosphorus (BP) is a type of relatively novel and promising material with some outstanding properties, such as its theoretical specific capacity (2596 mAh/g) being ...

Abstract This comprehensive review aims to critically analyse and summarise current research on the utilisation of phosphorene derived from black phosphorus in energy storage applications. ...

In this review, first, the fundamentals of phosphorus allotropes, phosphorene, and black phosphorus, are briefly introduced, along with their structures, properties, and ...

Finally, the challenges and opportunities of phosphorene nanosheets in terms of exfoliation and energy storage applications are addressed. The emerged 2D black phosphorus ...