Hydrogel flexible energy storage

Are hydrogel electrolyte materials suitable for flexible energy storage devices?
Herein, the state-of-art advances of hydrogel electrolyte materials for flexible energy storage devices are reviewed. In addition, devices with various kinds of functions, such as self-healing, shape memory, and stretchability, are included to stress upon the role of hydrogel materials.

Why are hydrogels important for energy storage?
The high-water content of hydrogels enables the network to maintain solid stability while providing free ions with molecular dynamics similar to liquids, which favors the further development of flexible energy storage devices .

What is a flexible hydrogel used for?
This flexible hydrogel can be used to apply to wearable electronics,smart clothes or flexible robots . The preparation of durable materials with excellent properties is essential for the development of wearable electronic devices.

Are biopolymer-based hydrogels a good choice for energy storage and conversion?
Due to their affordability,environmental friendliness,and degradability,biopolymer-based hydrogels have been considered to be competitive candidatesfor flexible and intelligent electrochemical energy storage and conversion devices .

Are multifunctional hydrogels suitable for energy storage and conversion?
This is largely due to their exceptional mechanical properties, inherent multifunctionality, and noteworthy biocompatibility. The goal of this review is to provide an in-depth analysis of the recent advancements made in the field of multifunctional hydrogels as applied to energy storage and conversion.

Are solid-state hydrogel electrolytes suitable for energy storage?
Volume 73, Part A, 1 December 2023, 108810 The fabrication of highly flexible, solid-state hydrogel electrolytes remains challenging because of the unavoidable mechanical stress. Solid-state hydrogel electrolytes demonstrate an effective design for a sufficiently tough energy storage device.

With the development of intelligent wearable devices, their practical applications not only require energy storage devices to have high flexibility and toughness, but also require them to have simple structure and excellent self-healing [[1], [2], [3]].Therefore, the development of flexible supercapacitors with high power density and long cycle life is crucial for wearable ...

In the third case, polymers were primarily discussed in relation to their use as gel electrolytes [89, 111] or electrodes (e.g., conducting polymers) [112] for flexible energy storage devices, mostly limited to thin films. To summarize, there is currently no comprehensive review available that fully covers polymer materials in

terms of ...

To cater to the swift advance of flexible wearable electronics, there is growing demand for flexible energy storage system (ESS). Aqueous zinc ion energy storage systems (AZIESSs), characterizing safety and low cost, are competitive candidates for flexible energy storage. Hydrogels, as quasi-solid substances, are the appropriate and burgeoning ...

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In this work, we present a flexible electrochemical energy storage device that utilizes modified graphite electrodes and a PVA/SA hydrogel electrolyte. The graphite threads ...

Recent works have reported significant advances in hydrogel-based flexible energy storage devices with unique electrochemical and mechanical properties. Unfortunately, as water freezing or dehydration, hydrogel-based energy storage devices naturally suffer from severe performance degradation under actual environments, which limits their ...

Novel flexible storage devices such as supercapacitors and rechargeable batteries are of great interest due to their broad potential applications in flexible electronics and implants. Hydrogels are crosslinked hydrophilic polymer networks filled with water, and considered one of the most promising electrolyte candidates due to their high-water ...

The integration of ultraflexible energy harvesters and energy storage devices to form flexible power systems remains a significant challenge. Here, the authors report a system consisting of ...

As one of the core components of flexible energy storage devices, electrolytes play an important role in practical application. Thus, various flexible electrolytes have been designed for flexible energy storage devices in wearable electronic devices [65, 66]. Among them, environment-adaptable hydrogel electrolytes have a certain flexibility ...

Hydrogel electrolytes, renowned for their mechanical robustness and versatility, are crucial in ensuring stable energy output in flexible energy storage devices. This work presents a dual cross-linked cellulose-based hydrogel electrolyte with chemical cross-linking from covalent bonding and physical cross-linking from hydrogen bonding.

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Since the last decade, the need for deformable electronics exponentially increased, requiring adaptive energy

storage systems, especially batteries and supercapacitors. Thus, the conception and elaboration of new deformable electrolytes becomes more crucial than ever. Among diverse materials, gel polymer electrolytes (hydrogels, organogels, and ionogels) ...

One could argue that hydrogels have played a central, starring role for the assembly of flexible supercapacitors for energy storage applications. This work stresses the importance of producing flexible supercapacitors for wearable clothing applications and the current challenges of hydrogel-based supercapacitors.

Here, the state-of-the-art advances of the hydrogel materials for flexible energy storage devices including supercapacitors and rechargeable batteries are reviewed.

As the demand for flexible wearable electronic devices increases, the development of light, thin and flexible high-performance energy-storage devices to power them is a research priority. This review highlights the latest research advances in flexible wearable supercapacitors, covering functional classifications such as stretchability, permeability, self ...

Flexible Energy Storage Systems Based on Electrically Conductive Hydrogels Wei Zhang1,*, Pan Feng1, Jian Chen1,*, Zhengming Sun1, Boxin Zhao2,3,4 1School of Materials Science and Engineering, Jiangsu Key Laboratory for Advanced Metallic Materials, Southeast University, China 2Department of Chemical Engineering, 3Waterloo Institute for Nanotechnology, ...

Here, the state-of-the-art advances of the hydrogel materials for flexible energy storage devices including supercapacitors and rechargeable batteries are reviewed. In ...

Hydrogel materials are receiving increasing research interest due to their intriguing structures that consist of a crosslinked network of polymer chains with interstitial spaces filled with solvent water. This feature endows the materials with the characteristics of being both wet and soft, making them ideal candidates for electrolyte materials for flexible energy storage ...

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This self-healing hydrogel electrolyte with excellent stretchability and high ionic conductivity is expected to pave the way for the development of high-performance flexible ...

Generally, gel polymer electrolyte (GPE) that consists of an aqueous electrolyte and polymer matrix in shape of hydrogel has been applied as one of the useful candidates in flexible energy storage devices to prevent the leakage of electrolyte [82].

Therefore, this study proposes an innovative chemistry into the design of highly Na-ion conducting and flexible hydrogel electrolytes to overcome the tradeoff of existing gel electrolytes between ionic conductivity and mechanical integrity, as well as the development of flexible Na-ion hybrid energy storage devices with the large energy and ...

To investigate the electrochemical performances and demonstrate the feasibility of the resulting hybrid conductive hydrogels for high-performance energy storage devices, a PVA-H 3 PO 4 gel electrolyte was sandwiched between two pieces of hydrogel electrodes to assemble all-hydrogel SCs. Notably, C-MXene could also influence the electrochemical ...

To develop electrolytes suitable for flexible energy storage devices, it is imperative to modify the physical state of the electrolyte to a solid or quasi-solid form, thereby preventing any leakage during mechanical deformation. ... Therefore, the development of flexible hydrogel electrolytes holds significant importance in assembling flexible ...

This review compiles the state-of-the-art and the progress in hydrogel materials for flexible energy storage applications with a focus on supercapacitors and lithium-ion ...

Conductive hydrogels (CHs) have shown great potential in smart wearable devices and energy storage due to their unique advantages, such as the mechanical properties and physiological characteristics similar to human skins and tissues (stretchability, low modulus, flexibility, biocompatibility, etc.), the function and structure design with diversity, and the ...

Fig. 5 a presents the CV curves of the gel-based energy storage device, where a clear pair of redox peaks can be observed, ... Furthermore, flexible zinc-ion energy storage devices were fabricated using a combination of hydrogel and PB film. These devices were subjected to 600 s of compression under various gears of the motor. In Fig. S17, the ...

As a functional electrolyte in flexible energy storage and conversion devices, biopolymer-based hydrogels have received extensive attention in energy storage and conversion applications recently. The general features and molecular structures of the most commonly used biopolymers for the fabrication of various hydrogel electrolytes for energy ...

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Hydrogel is an ideal material for flexible electrochemical energy storage components due to its good conductivity and softer texture, which is expected to promote electrochemical energy storage technology toward high efficiency, durability, environmental protection, etc., and expand the application range.

5 · Flexible supercapacitors (SCs), as promising energy storage devices, have shown great potential for both next-generation wearable electronics and addressing the global energy crisis. Conductive hydrogels (CHs) are suitable electrode materials for flexible SCs on account of their intrinsic characteristics and functional advantages, such as a unique 3D porous structure, ...

DOI: 10.1016/j.carbpol.2024.122444 Corpus ID: 270825936; Dual cross-linked cellulose-based hydrogel for dendrites-inhibited flexible zinc-ion energy storage devices with ultra-long cycles and high energy density.