

Are spintronic devices energy efficient?

The current surge in data generation necessitates devices that can store and analyze data in an energy efficient way. This Review summarizes and discusses developments on the use of spintronic devices for energy-efficient data storage and logic applications, and energy harvesting based on spin.

Can spin state regulation improve energy storage performance?

This review aims to elucidate the advantages of controlling the spin states of metal centers to enhance energy storage performance and highlights recent progress in employing spin state regulation in electrochemical energy storage. Additionally, it covers the various characterization techniques used to determine spin states.

Why do spintronics devices use less power?

On contrast, less energy is needed to switch the spin states from 0 to 1 or vice versa, so spintronics devices use less power. Comparing with conventional electronics, using a single chip to perform many functions makes the device faster and small.

Why are spintronic devices so popular?

Though the concept of electron spin was realized in the 1920s only, challenges in fabrication technology have hindered the development of spintronic devices and circuits. Spintronic devices hold supremacy in terms of their non-volatility, scalability, ease to read and write, and high endurance over the CMOS devices.

Can spin information be used for energy harvesting?

In terms of energy harvesting with spin information, perhaps the most revolutionary concept in the last years has been the advent of the spin Seebeck effect and anomalous Nernst effect with already on-going commercial thermoelectric device developments.

Why is spintronics not energy-dependent?

In spintronics, the spin of electron is not energy-dependent (i.e., nonvolatile, permanent magnetism) which means that the information remains fixed if power is cutoff. Also, the capacitors in conventional electronics are constantly recharged (consume more energy) due to charge is leaking out.

We formulate an energy-storage concept based on the free energy associated with metastable magnetic configurations. Despite the active magnetic region of the battery being electrically insulating, it can sustain ...

This review introduces the application of magnetic fields in lithium-based batteries (including Li-ion batteries, Li-S batteries, and Li-O₂ batteries) and the five main mechanisms involved in promoting performance. This figure reveals the influence of the magnetic field on the anode and cathode of the battery, the key materials involved, and the trajectory of the lithium ...

Due to their intriguing electronic properties and structural composition, transition metal oxides (TMOs) such

as AO_x , AxO_x , and $\text{AxB}_{3-x}\text{O}_x$; A, B = Ti, V...

Compressed air energy storage (CAES) systems use off-peak electricity to compress air, storing it in underground caverns or storage tanks. This air is later released to a combustor in a gas turbine to generate electricity during peak periods. Flywheels are mechanical devices that spin at high speeds, storing electricity as rotational energy.

Here, we provide an overview of the current status of research and technology developments in data storage and spin-mediated energy harvesting in relation to energy-efficient technologies.

This review describes an emerging field of electronics devices; electron spin exploitation use for a further degree of freedom incorporation to charge state, with the ...

Atomic spin engineering of Fe-N-C by axial chlorine-ligand modulation for lightweight and efficient electromagnetic wave absorption ... technologies based on high-frequency and high ...

The energy devices for generation, conversion, and storage of electricity are widely used across diverse aspects of human life and various industry. Three-dimensional (3D) printing has emerged as ...

Energy storage devices such as electrochemical capacitors, fuel cells, and batteries efficiently transform chemical energy into electrical energy. Batteries convert chemical energy into electrical energy by means of a redox reaction between the anode and cathode. ... The spin energy states of an electron can improve the capacitance under a ...

The field of spintronics has attracted tremendous attention recently owing to its ability to offer a solution for the present-day problem of increased power dissipation in electronic circuits while scaling down the technology. Spintronic ...

We formulate an energy-storage concept based on the free energy associated with metastable magnetic configurations. Despite the active, magnetic region of the battery being electrically ...

Such devices can display highly useful properties, such as non-volatility, low energy consumption, fast processing speed, and scalability to tiny dimensions that allow for high density. A spintronic device usually comprises several magnetic layers ...

The printing MXenes for energy storage devices such as supercapacitors and particularly batteries have been recently focused. The rise for such energy storage devices was more than 100 % in just last four years. ... Recently, Imprint Energy, a spin-off from the University of California, Berkeley, and Australia's Printed Energy entered the ...

2D materials are attractive for nanoelectronics due to their ultimate thickness dimension and unique physical

properties. A wide variety of emerging spintronic device concepts will greatly benefit ...

The use of multiferroics allows the realization of competitive energy efficient scalable logic and storage devices. The low - power consumption in Magneto Electric - Spin Orbital logics [1] and Magnetic Random Access Memory components is provided by magnetoelectric switching in multiferroic - based systems using a low-energy electric field.

In this Review, we contextualize spintronic logic within the broader goals of beyond-CMOS computing. We then provide an overview of five types of spintronic logic, ...

This review article also talks about the recent development and advancement in the biopolymer-based electrochemical devices in great detail. We have discussed the fundamental properties, factor affecting ion-transport mechanisms and demonstrated state of the art ion-conducting membranes for energy applications.

This Review Article examines the potential of spintronics in four key areas of application --memories, sensors, microwave devices, and logic devices -- and discusses the challenges that need be ...

The released energy can power the wheels of a toy car, drive a toy frog or toy kangaroo to jump, or drive a toy top to spin [32, 33]. (2) ... Elastic energy storage devices using spiral springs can be designed to harvest and store the random mechanical input energy and adapt to small torque input. Furthermore, the stored energy can be released ...

Persistent radicals can hold their unpaired electrons even under conditions where they accumulate, leading to the unique characteristics of radical ensembles with open-shell structures and their molecular properties, such as ...

This paper employs a jigsaw design to visually merge the concepts of spin and electrochemical energy storage, introducing the novel idea of spin-electrochemical energy storage. ... Abstract Developing high-capacity and cyclically stable transition metal (TM)-based electrode materials for energy storage devices, such as aqueous ion energy ...

devices (solar cell, water splitting system, fuel cell), energy conversion devices (triboelectric nanogenerator, piezoelectrics, thermoelectrics), and energy storage devices (battery, supercapacitor))

In this Review we discuss on-going efforts towards energy-efficient spintronic devices related to ICTs, incoming technologies, and open questions. We start our discussion ...

Developing high-capacity and cyclically stable transition metal (TM)-based electrode materials for energy storage devices, such as aqueous ion energy storage systems, ...

Electrospinning is a versatile fabrication method for synthesising mesostructured nanofibrous mats and has been explored in this review for the following electrochemical energy storage devices: redox flow batteries, fuel cells, metal air batteries and supercapacitors.

Transfer from conventional electronics to spintronics technology opens the possibilities to construct devices with high storage density, low power consumption, and fast ...

Wearable electronic devices need to be flexible and breathable, as well as show high performance. In this Review, 1D energy harvesting and storage devices -- in the form of fibre-based systems ...

Among different energy storage devices, supercapacitors have garnered the attention due to their higher charge storage capacity, superior charging-discharging performance, higher power density, and long cycle life. Subsequently, introducing low-cost and highly-efficient supercapacitors is a hot topic in the industrial and scientific realms. ...

Energy storage devices have been the current demand of the modern electronics and vehicle industry (Winter and Brodd, 2004; Simon and Gogotsi, 2010b; Larcher and Tarascon, 2015). The pseudocapacitors or ...

Selected studies concerned with each type of energy storage system have been discussed considering challenges, energy storage devices, limitations, contribution, and the objective of each study. The integration between hybrid energy storage systems is also presented taking into account the most popular types. Hybrid energy storage system ...

The Future of Energy Storage: Spin Quantum Batteries Charged Without External Fields February 24, 2025 Stefano Lovati. The exploration of spin quantum batteries by the University of Genova marks a significant ...

Figure 1. A schematic of a quasi-one-dimensional spin spiral of length that stores energy density, where is the order-parameter angle within the magnetic easy plane. The winding density of the easy()-plane directional ...

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