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Can film dielectrics improve energy storage performance? Film dielectrics possess larger breakdown strength and higher energy density than their bulk counterparts,holding great promise for compact and efficient power systems. In this article,we review the very recent advances in dielectric films,in the framework of engineering at multiple scales to improve energy storage performance.

Can ultra-thin multilayer structure improve energy storage performance of multilayer films? In this study, an innovative approach is proposed, utilizing an ultra-thin multilayer structure in the simple sol-gel made ferroelectric/paraelectric BiFeO 3 /SrTiO 3 (BF/ST) system to enhance the energy storage performance of multilayer films.

Does ultra-thin N24 film improve energy storage performance? Ultimately,in the ultra-thin N24 film,with each layer having a thickness of 6.7a??nm,we achieved a remarkable enhancement of energy storage performance,with Wrec reaching 65.8a??J/cm a??3 and efficiency reaching 72.3%. 2. Experimental 2.1. Synthesis of BiFeO 3 and SrTiO 3 precursors

Can dielectric energy storage films be used for fast charging capacitors? The rapid progress in microelectronic devices has brought growing focus on fast charging-discharging capacitors utilizing dielectric energy storage films. However,the energy density of these dielectric films remains a critical limitationdue to the inherent negative correlation between their maximum polarization (Pmax) and breakdown strength (Eb).

A flexible BiFeO 3-BaTiO 3 (BF-BT) capacitor exhibits a total energy density of 43.5 J cm a??3 and an efficiency of 66.7% and maintains good energy storage performance over a wide temperature range (20a??200 ?C) and under large bending deformation (bending radii a?? 2 mm). This study provides a feasible approach to improve the energy storage

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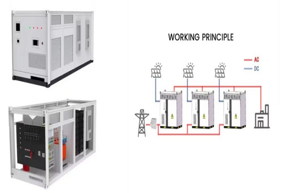
Due to high power density, fast charge/discharge speed, and high reliability, dielectric capacitors are widely used in pulsed power systems and power electronic systems. However, compared with other energy storage devices such as batteries and supercapacitors, the energy storage density of dielectric capacitors is low, which results in the huge system volume when applied in pulse a?|

Enhanced recoverable energy density of 44 J/cm 3, with a good thermal stability of energy storage density over temperature range of 40a??180 ?C, has been achieved in 0.9NBT-0.1BFO films. It is found that the introduction of BFO causes high polarization due to the existence of stereo-chemically active lone pair electrics in Bi 3+ .



The collective impact of two strategies on energy storage performance. aa??d) Recoverable energy storage density W rec and energy efficiency I. for 5 nm thin films of BTO, BFO, KNN, and PZT under various defect dipole densities and different in-plane bending strains (Different colored lines represent in-plane bending strains ranging from 0% to 5%).

Therefore, the development of flexible energy storage devices with durability and high performance under harsh conditions has emerged as a prominent research topic in the field of energy [4, 5]. Supercapacitors have gained great attention due to their superior power and energy density compared to conventional capacitors [[6], [7], [8], [9]].

Energy storage materials play a critical role in energy harvesting devices, as their performance greatly impacts energy harvesting efficiency [15], [16], [17].Energy storage materials are functional materials that utilize physical or chemical changes in substances to store energy [18], [19], [20].The ideal energy storage material should have high energy storage a?|

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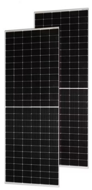
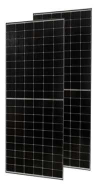


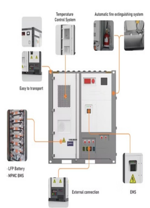

The energy crisis and the deteriorating living environment have challenged the sustainable economic and social development due to the over-consumption of non-renewable resources [[1], [2], [3]].To alleviate these problems, effective electrical storage is crucial to enhance the utilization of renewable energies and reduce the environmental pollution [4].


Especially in the 1.5% Mn-BMT 0.7 film capacitor, an ultrahigh energy storage density of 124 J cm-3 and an outstanding efficiency of 77% are obtained, which is one of the best energy storage performances recorded for ferroelectric capacitors. In addition, the flexible ferroelectric film capacitor also exhibits good thermal stability


For the fabrication of thin films, Physical Vapor Deposition (PVD) techniques specified greater contribution than all other deposition techniques. Laser Ablation or Pulsed Laser deposition (PLD) technique is the one of most promising techniques for the fabrication of thin films among all other physical vapor deposition. In particular, flexible thin-film energy storage a?|

Electrostatic capacitors are among the most important components in electrical equipment and electronic devices, and they have received increasing attention over the last two decades, especially in the fields of new energy vehicles (NEVs), advanced propulsion weapons, renewable energy storage, high-voltage transmission, and medical defibrillators, as shown in a?|



Thin film capacitors with large energy storage density and high breakdown strength are widely used in modern electronic fields. To solve the problems of interface effect and different polarization mechanism between matrix and fillers in conventional heterogeneous structure composite thin film capacitors, a new-type inorganic microcrystal-amorphous a?|

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Dielectric energy storage devices offer considerable application potential in distributed power sources, hybrid car power sources, consumer electronic gadgets, and renewable energy storage owing to their long lifespans, dependable stability, and rapid charging and discharging rates [1], [2], [3], [4].The high breakdown electric field (BEF) of dielectric a?|

As an important power storage device, the demand for capacitors for high-temperature applications has gradually increased in recent years. However, drastically degraded energy storage performance due to the critical conduction loss severely restricted the utility of dielectric polymers at high temperatures. Hence, we propose a facile preparation method to suppress a?|

Here, guided by theoretical and phase-field simulations, we are able to achieve a superior comprehensive property of ultrahigh efficiency of 90a??94% and high energy density of 85a??90 J a?|

1 INTRODUCTION. Energy storage capacitors have been extensively applied in modern electronic and power systems, including wind power generation, 1 hybrid electrical vehicles, 2 renewable energy storage, 3 pulse power systems and so on, 4, 5 for their lightweight, rapid rate of chargea??discharge, low-cost, and high energy density. 6-12 However, dielectric polymers a?|

In this work, it is the first time as far as we know to study the effect of A-site Ni doping on the energy storage performance of BTO. The Ni-doped BTO (BN x T, x = 0, 0.02, 0.04, 0.06, 0.08) thin films were synthesized by sol-gel and spin-coated method, the structure, ferroelectric, dielectric and energy storage properties of these films were investigated, and the a?|

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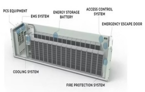
The specific energy storage properties are shown in Fig. 8 (e). As the temperature increases, the recoverable energy storage density decreases from 15.2 J/cm 3 to 14.7 J/cm 3, a change of 3.3%, and the energy efficiency decreases from 88.5% to 82.4%, a change of 6.9%, indicating excellent temperature stability of the films. This broad


Ultrahigh energy storage density of 52.4 J cma??3 with optimistic efficiency of 72.3% is achieved by interface engineering of epitaxial lead-free oxide multilayers at room temperature. Moreover, the excellent thermal a?|





With the rapid development of energy storage and conversion technology, it has become a hot topic in the field of scientific research to find energy storage materials with high efficiency, high energy storage density and long-life [[1], [2], [3], [4]] pared with batteries and electrochemical capacitors, dielectric capacitors have the advantages of high power density a?|


The development and integration of high-performance electronic devices are critical in advancing energy storage with dielectric capacitors. Poly(vinylidene fluoride-trifluoroethylene-chlorofluoroethylene) (PVTC), as an energy storage polymer, exhibits high-intensity polarization in low electric strength fields. However, a hysteresis effect can result in a?|


Epoxy resin (EP), as a kind of dielectric polymer, exhibits the advantages of low-curing shrinkage, high-insulating properties, and good thermal/chemical stability, which is widely used in electronic and electrical industry. However, the complicated preparation process of EP has limited their practical applications for energy storage. In this manuscript, bisphenol F a?|

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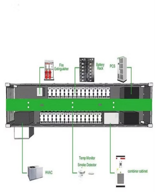
Phase change energy storage technology, as an efficient means of energy storage, has an extremely high energy storage density, and can store or release thermal energy under isothermal conditions, which is an effective means of improving the imbalance between energy supply and.




Additionally, the fascinating properties owned by borophene, including superconductive, elastic, thermal, optical properties, topological properties, as well as low energy barrier of Li/Na/K/Mg/Al ion transport, make it a competitive candidate for future nano-devices, especially for energy storage devices [8], [9] fact, there are several works that addressed a?|


Phase change energy storage technology, as an efficient means of energy storage, has an extremely high energy storage density, and can store or release thermal energy under isothermal conditions, which is an effective means of improving the imbalance between energy supply and demand. The major carrier of phase change energy storage technology


The energy storage properties of the PPL film are consistent with being in this temperature range. To assess the effectiveness of thermotherapy, this paper examines the actual temperature variation of PPL to illustrate the practical personal thermal management suitability of the material. In this work, a dynamic thermal evaluation system with a


Electrochemical batteries, thermal batteries, and electrochemical capacitors are widely used for powering autonomous electrical systems [1, 2], however, these energy storage devices do not meet output voltage and current requirements for some applications.Ferroelectric materials are a type of nonlinear dielectrics [[3], [4], [5]].Unlike batteries and electrochemical a?|

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The fluctuation rate of its energy storage density at 20a??200 ?C and after 8 x 10 4 cycles was rated at 1.3% and 11.96%, respectively, indicating good thermal and cyclic stability. These overall characteristics make this high-performance thin film as a promising candidate for pulsed and switched capacitive energy storage.


To improve the energy storage stability of a ferroelectric film capacitor, we propose to weaken its ferroelectricity by introducing a larger linear dielectric component into its a?|


Thin-film batteries are solid-state batteries comprising the anode, the cathode, the electrolyte and the separator. They are nano-millimeter-sized batteries made of solid electrodes and solid electrolytes. The need for lightweight, higher energy density and long-lasting batteries has made research in this area inevitable. This battery finds application in consumer a?|


An energy density of 3 J cm a??3 is successfully achieved with giant power density on the order of 2 MW cm a??3, which is four orders of magnitude higher than that of any other type of energy storage device. The outputs of multilayer structures can be precisely controlled by the parameters of the ferroelectric layer and the number of layers.


The dielectric energy storage performance of HBPDA-BAPB manifests better temperature stability than CBDA-BAPB and HPMDA-BAPB from RT to 200 ?C, mainly due to the exceptionally high and stable chargea??discharge efficiency of >98.5 %. This allows HBPDA-BAPB to have a relatively low energy loss density within a wide operating temperature range.

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In this study, epitaxial antiferroelectric PbHfO 3 films with different orientations are fabricated, in which remarkable anisotropies of polarization and energy storage properties are discovered. With the optimization of film orientation, much-improved energy density and excellent high-temperature efficiency are achieved in the PbHfO 3 films.

Ferroelectric Aurivillius compounds have the unique electric resistance and fatigue-free features due to the natural superlattice structure, which is benefit for exploring high energy storage performance. However, the inherent constraints of relatively low polarization and large hysteresis seriously hamper their applications in energy storage field. In this work, the a?|