

Does high entropy affect energy storage performance?

As a result, a giant  $W_{rec} \sim 10.06 \text{ J cm}^{-3}$  and an ultrahigh  $\eta \sim 90.8\%$  are simultaneously achieved in the KNN-H ceramic, showing a significant promotional effect of the high-entropy strategy on the energy storage performance (236% for  $E_b$ , 1729% for  $W_{rec}$ , 68% for  $\eta$ , Supplementary Fig. 6c).

How to achieve a good energy storage density?

According to the above definition, the key to achieve excellent energy storage density is to increase  $P_{max}$  while reducing  $P_r$  (i.e., obtaining high  $DP = P_{max} - P_r$ ) and enhancing  $E_b$ , the breakdown strength, which is closely associated with the maximum applied electric field the ceramics can withstand.

Can high-entropy strategy improve energy storage performance in tetragonal tungsten bronze-structured dielectric ceramics?

However, the development of dielectric ceramics with both high energy density and efficiency at high temperatures poses a significant challenge. In this study, we employ high-entropy strategy and band gap engineering to enhance the energy storage performance in tetragonal tungsten bronze-structured dielectric ceramics.

Which lead-free ceramic systems have the best energy storage properties?

Further breakthroughs in energy storage properties were also achieved in other representative lead-free ceramic systems, such as the excellent  $W_{rec}$  values of 7.4, 8.2, and  $12.2 \text{ J cm}^{-3}$  in (K,Na)NbO<sub>3</sub> (KNN), BiFeO<sub>3</sub> (BF), and NaNbO<sub>3</sub> (NN)-based systems, respectively 7, 8, 9.

Can 'local polymorphic distortion' improve energy storage performance?

In this work, an effective high-entropy strategy is proposed to design "local polymorphic distortion" to enhance the comprehensive energy storage performance to break the status quo, which has usually been used for alloys 22, 23, oxides 24, 25, and metal carbides 26 to improve mechanical properties.

Does the energy storage performance of BSCNT0.30 exhibit high-temperature stability?

The change rates were less than 5% and 3%, respectively. This outcome illustrates that, owing to the high-entropy effect, the energy storage performance of BSCNT0.30 exhibits excellent temperature stability. To delve deeper into the reason behind the high-temperature stability of BSCNT0.30, its structural changes with temperature were tested.

The great potential of  $\text{K}_{1/2}\text{Bi}_{1/2}\text{TiO}_3$  (KBT) for dielectric energy storage ceramics is impeded by its low dielectric breakdown strength, thereby limiting its utilization of high polarization. This study develops a novel composition,  $0.83\text{KBT}-0.095\text{Na}_{1/2}\text{Bi}_{1/2}\text{ZrO}_3-0.075\text{Bi}_{0.85}\text{Nd}_{0.15}\text{FeO}_3$  (KNBNTF) ceramics, demonstrating outstanding energy storage ...

To overcome these shortcomings and optimize the energy storage performance of BiFeO<sub>3</sub>-based ceramics, complicated perovskite oxides (0.7-x)Bi<sub>0.9</sub>La<sub>0.1</sub>FeO<sub>3-0.3</sub>Ba<sub>0.7</sub>Sr<sub>0.3</sub>TiO<sub>3-x</sub>NaNb<sub>0.85</sub>Ta<sub>0.15</sub>O<sub>3</sub> [abbreviated as (0.7-x)BLF-0.3BST-xNNT] were proposed and methodically investigated in the current work based on the following considerations: (i) The ...

Fe<sub>3</sub>S<sub>4</sub> Nanoparticles Wrapped in an rGO Matrix for Promising Energy Storage: Outstanding Cyclic and Rate Performance. Sheng-Ping Guo \*, Jia-Chuang Li, Jin-Rong Xiao, and ; Huai-Guo Xue \* ... Bimetallic Selenide LiInSe<sub>2</sub> Decorated with a Uniform Carbon Layer with Superior Lithium Storage Performance. ChemElectroChem 2020, 7 (1 ...

In this work, outstanding energy storage performance is achieved in Sr<sub>0.7</sub>BixTiO<sub>3</sub> (x = 0.1, 0.2, 0.3 and 0.4) ceramics via A-site defect and grain size tuning. It was found that the moderate Bi&#179; ...

This study proposes a viable route to better performance of dielectric ceramics for energy storage, and the outstanding performance of the 0.8(BNT-NN)-0.2SSN (RRP) ceramic indicates its ...

Here, an ultrahigh recoverable energy storage density W<sub>rec</sub> of 77.57 J cm<sup>-3</sup> and a large efficiency η of 81.4% are first realized in (Bi<sub>0.5</sub>K<sub>0.5</sub>)TiO<sub>3</sub> (BKT)-based relaxor ferroelectric ceramics with an ultrahigh Vickers hardness H<sub>v</sub> 8.63 ...

Due to urbanization and the rapid growth of population, carbon emission is increasing, which leads to climate change and global warming. With an increased level of fossil fuel burning and scarcity of fossil fuel, the power industry is moving to alternative energy resources such as photovoltaic power (PV), wind power (WP), and battery energy-storage ...

Outstanding Energy Storage Performance in High-Hardness (Bi<sub>0.5</sub>K<sub>0.5</sub>)TiO<sub>3</sub>-Based Lead-Free Relaxors via Multi-Scale Synergistic Design. Liang Chen, Liang Chen. Beijing Advanced Innovation Center for Materials Genome Engineering, University of Science and Technology Beijing, Beijing, 100083 China.

In view of the high-energy density and long-term cycling stability, lithium-ion batteries (LIBs) are outstanding in varieties of energy storage devices. [ 1 - 5 ] However, the demand for advanced LIBs is ever-increasing to high ...

NaNbO<sub>3</sub> (NN)-based ceramics have received a great deal of attention for the potential application in dielectric energy storage capacitors. However, the energy storage properties (ESP) remain low, particularly under moderate electric field. Herein, a Bi-rich doping unit of BiMg<sub>2/3</sub>Nb<sub>1/3</sub>O<sub>3</sub> (BMN) was introduced into a 0.85NaNbO<sub>3</sub>-0.15Bi<sub>0.1</sub>Sr<sub>0.85</sub>TiO ...

A giant W<sub>rec</sub> ~10.06 J cm<sup>-3</sup> is realized in lead-free relaxor ferroelectrics, especially with an ultrahigh η

~90.8%, showing breakthrough progress in the comprehensive ...

These devices can be used as devices of choice for future electrical energy storage needs due to their outstanding performance characteristics. Based on their performance, supercapacitors can be placed somewhat in middle of rechargeable batteries and conventional electrostatic capacitors since supercapacitors have higher energy and power ...

Outstanding Energy Storage Performance in High-Hardness (Bi<sub>0.5</sub>K<sub>0.5</sub>)TiO<sub>3</sub>-Based Lead-Free Relaxors via Multi-Scale Synergistic Design Journal Article &#183; Sun Nov 21 00:00:00 EST 2021 &#183; Advanced Functional Materials

Lead-free dielectric ceramics with ultrahigh energy storage performance are the best potential stocks used in next-generation advanced pulse power capacitors. Here, an ultrahigh recoverable energy storage density  $W_{rec}$  of 77.57 J cm<sup>-3</sup> and a large efficiency  $\eta$  of 81.4% are first realized in (Bi<sub>0.5</sub>K<sub>0.5</sub>)TiO<sub>3</sub> (BKT)-based relaxor ferroelectric ceramics with an ultrahigh ...

This work provides a feasible pathway for substantially improving comprehensive ESP of lead-free ceramics, and also highlights advanced energy storage potential of the BNT ...

Different from most of the studies on dielectric energy storage thin films, which mainly talk about domain engineering or interface engineering, our work revealed the effect of the interaction between film and bottom electrode on the energy storage performance of ferroelectric multilayers by fabricating multilayers of BaTiO<sub>3</sub> (BT) and SiO<sub>2</sub> ...

Ultrahigh energy-storage performance of dielectric ceramic capacitors is generally achieved under high electric fields (HEFs). However, the HEFs strongly limit the miniaturization, integration, and lifetime of the dielectric energy-storage capacitors. Thus, it is necessary to develop new energy-storage materials with excellent energy-storage densities under moderate ...

Dielectric energy-storage capacitors are of great importance for modern electronic technology and pulse power systems. However, the energy storage density ( $W_{rec}$ ) of dielectric capacitors is much lower than lithium batteries or supercapacitors, limiting the development of dielectric materials in cutting-edge energy storage systems. This study presents a single-phase ...

Superior energy-storage performance of a giant energy-storage density  $W_{rec}$  8.12 J cm<sup>-3</sup>, a high efficiency  $\eta$  90%, and an excellent thermal stability (&#177;10%, -50 to 250 &#176;C) and an ...

@article{Li2024RealizingOE, title={Realizing Outstanding Energy Storage Performance in KBT-Based Lead-Free Ceramics via Suppressing Space Charge Accumulation.}, author={Yexin Li and Ziliang Chang and Manlin Zhang and Mankang Zhu and Mupeng Zheng and Yudong Hou and Qiyuan Zhou and Xiaolian Chao

and Zupei Yang and He Qi and Jun Chen ...

Along with the rapid development of electrostatic capacitors requiring dielectric materials to exhibit environmental-friendly and outstanding performance, numerous efforts have been made to enhance the energy storage properties of lead-free ceramics for pulsed power capacitor applications in recent reports [39], [40], [41], [42].

An outstanding energy storage density of  $W_{rec} \sim 6.378 \text{ J/cm}^3$ , a high  $E_b$  of 402 kV/cm, and an excellent temperature ( $-120 \sim 120 \text{ }^\circ\text{C}$ ) ... Although the above methods have improved the energy storage performance to a certain extent, each strategy is difficult to achieve a comprehensive improvement in energy storage performance alone. ...

Yang, C. et al. Fatigue-free and bending-endurable flexible Mn-doped  $\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3\text{-BaTiO}_3\text{-BiFeO}_3$  film capacitor with an ultrahigh energy storage performance. *Adv. Energy Mater.* 9, 1803949 ...

Nowadays, with the application and popularization of modern power electronic devices and high-voltage electrical systems, and other high-tech industries, there is an urgent need for polymer dielectric materials with excellent high-temperature capacitor energy storage performance [1, 2]. Polymer dielectric materials have become the main choice for high-voltage ...

Dielectric ceramics with outstanding energy storage performance are urgently expected for energy storage capacitors. In this work, high energy storage density were achieved by deliberately ...

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