Antiferroelectric energy storage performance

Can antiferroelectric materials be used for energy storage?
Antiferroelectric materials have shown potential applications in energy storage. However,controlling and improving the energy-storage performance in antiferroelectric remain challenging. Here,a domain structure and energy-storage performance diagram for Pb (Zr 1-x Ti x)O 3 (x <= 0.1) single crystal are investigated via phase-field simulations.

Can antiferroelectric materials be used for power capacitive devices?
Antiferroelectric materials are promisingto be used for power capacitive devices. To improve the energy storage performance,solid-solution and defect engineering are widely used to suppress the long-range order by introducing local heterogeneities.

Are antiferroelectrics a promising material with high energy density?
Continued efforts are being devoted to find materials with high energy density,and antiferroelectrics (AFEs) are promisingbecause of their characteristic polarization-electric field (P - E) double hysteresis loops schematized in Fig. 1a (ref. 4).

Can antiferroelectric materials store energy in pulsed-power technologies?
The polarization response of antiferroelectrics to electric fields is such that the materials can store large energy densities,which makes them promising candidatesfor energy storage applications in pulsed-power technologies. However,relatively few materials of this kind are known.

How does nanoscale heterogeneity affect the energy storage performance of antiferroelectric?
Herein,by engineering the nanoscale heterogeneity to mitigate hysteresis and controlling orientation to enhance the polarization,the exceptional energy storage performance of antiferroelectric (Pb 0.97 La 0.02) (Zr 0.55 Sn 0.45)O 3 epitaxial thin films is demonstrated.

Do relaxor anti-ferroelectrics improve energy-storage performance?
Conclusion We have developed novel relaxor anti-ferroelectrics,which integrate the advantages of relaxor ferroelectrics (small hysteresis),antiferroelectrics (large D P),and strengthened polarization (large Pmax),giving comprehensive improvementof the energy-storage performance.

In this work, we test the performance of ferroelectric/paraelectric superlattices as artificial antiferroelectrics for energy storage, taking PbTiO 3 /SrTiO 3 as a relevant model ...

This energy storage performance is on a par with that of the AgNbO 3 film reported by Zhang et al. [28] at the same applied electric field of 0.6 MV·cm -1, but our ANT 700-STA film showed a ...

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DOI: 10.1016/j.jmat.2024.04.016 Corpus ID: 270500129; Antiferroelectric domain modulation enhancing energy storage performance by phase-field simulations @article{Xu2024AntiferroelectricDM, title={Antiferroelectric domain modulation enhancing energy storage performance by phase-field simulations}, author={Ke Xu and Shiyu Tang and ...

Energy storage materials and their applications have long been areas of intense research interest for both the academic and industry communities. Dielectric capacitors using antiferroelectric materials are capable of displaying higher energy densities as well as higher power/charge release densities by comparison with their ferroelectric and linear dielectric ...

The effects of Eu 3+ and Hf 4+ additions on the phase, microstructure, transmittance, and energy-storage performance of AgNbO 3 transparent antiferroelectric ceramics were systematically studied. The results show that a few Hf 4+ ions doped into the AgNbO 3 matrix do not change the perovskite structure of AgNbO 3 .

Antiferroelectric materials are promising to be used for power capacitive devices. To improve the energy storage performance, solid-solution and defect engineering are widely ...

Regulating the switching electric field and energy-storage performance in antiferroelectric ceramics via heterogeneous laminated engineering. Author links open overlay panel Xiaohui Liu a, Tongqing Yang a, Yan Li ... the energy storage performance shows no obvious deterioration in a broad frequency range (1-100 Hz) and temperature range (25 ...

At the optimal composition of x=0.11, the antiferroelectric-trirelaxor nanocomposite ceramic exhibits an outstanding energy storage performance from room temperature (energy density=8.5 J/cm 3, efficiency=94.8% and a high figure of merit of 167 J/cm 3) up to a high temperature of 200°C (energy density ~4.85 J/cm 3, efficiency>90% and figure ...

In consideration of environmental protection and energy demand, it is an inevitable trend to explore lead-free dielectric ceramics with high energy storage performance. The lead-free antiferroelectric ceramics based on silver niobate (AgNbO3) with double hysteresis loops have been proved to be a potential energy storage material. AgNbO3-based ...

AgNbO 3-based antiferroelectric materials have attracted extensive attention in energy storage due to their double polarization-electric field hysteresis loops, but they always suffer from low breakdown strength (E b) lms with few defects and small thickness exhibit high breakdown strength, which helps to improve energy storage performance. In the present work, ...

Incorporating antiferroelectric ceramic particles into a polymer matrix is beneficial for improving the energy storage performance of composites. However, excessive amounts of ceramic particles can lead to aggregation within the polymer, resulting in defects and a significant reduction in composite film performance.

Generally, the energy storage performance (ESP) can be calculated by polarization versus electric field (P-E) curve, as following [5]: (1) W = ? 0 P max EdP, (2) W rec = ? P r P max EdP, (3) i = W rec / W, where W is the total energy storage density, W rec is the recoverable energy storage density, P is the polarization, P max is the ...

DOI: 10.1016/J.JMAT.2021.02.018 Corpus ID: 233812178; AgNbO3 antiferroelectric film with high energy storage performance @article{Zhang2021AgNbO3AF, title={AgNbO3 antiferroelectric film with high energy storage performance}, author={Yanle Zhang and Xiaobo Li and Jianmin Song and Suwei Zhang and Jing Wang and Xiuhong Dai and Bao ...

The breakdown electric field of NaNbO3-based antiferroelectric (AFE) ceramics is low, which makes it difficult to improve its energy-storage density. In this study, by adding nano-SiO2, sintering temperature of 0.88Na0.94Sm0.02NbO3-0.12Sr0.7Bi0.2TiO3 (NN-SBT-2Sm) relaxor AFE ceramics was reduced from 1150 to 980 °C. Mean grain size of NN-SBT-2Sm ...

Furthermore, the newly developed composites exhibit better energy storage characteristics at 120 °C, with a high W rec of 3.5 J cm -3 as well as a high i of 91%. This study demonstrates that the design of a relaxor/antiferroelectric composite provides a highly effective method to improve the energy storage performance of lead-free ceramics.

In recent years, high performance energy storage technologies and devices have attracted tremendous research in academia and industry, influenced by the growing demand for electrical energy and excessive consumption of conventional energy sources in current society [1], [2], [3].Up to date, based on the redox reactions (like lithium batteries, fuel cells and super ...

Antiferroelectric materials are promising to be used for power capacitive devices. To improve the energy storage performance, solid-solution and defect engineering are widely used to suppress the long-range order by introducing local heterogeneities. However, both methods generally deteriorate either the maximum polarization or breakdown electric field due ...

In recent decades, the energy storage performance of lead zirconate-based antiferroelectric materials has been developed significantly, ... Regulating the switching electric field and energy-storage performance in antiferroelectric ceramics via heterogeneous laminated engineering. Ceram. Int. (2024), 10.1016/j.ceramint.2024.06.402.

The development of antiferroelectric (AFE) materials with high recoverable energy-storage density (Wrec) and energy-storage efficiency (i) is of great importance for meeting the requirements of miniaturization and integration for advanced pulse power capacitors. However, the drawbacks of traditional AFE materials, namely, high critical field (Ecr) and low ...

Local defect structure design enhanced energy storage performance in lead-free antiferroelectric ceramics. Author links open overlay panel Peixuan Li a, Simin Wang a b c, Jin Qian a, ... Energy storage performance of BaTiO 3-based relaxor ferroelectric ceramics prepared through a two-step process. Chem. Eng. J., 419 (2021), Article 129673.

Antiferroelectric (AFE) materials are promising for the applications in advanced high-power electric and electronic devices. Among them, AgNbO 3 (AN)-based ceramics have gained considerable attention due to their excellent energy storage performance. Herein, multiscale synergistic modulation is proposed to improve the energy storage performance of AN-based ...

Here, E and P denote the applied electric field and the spontaneous polarization, respectively. According to the theory of electrostatic energy storage, high-performance AFE capacitors should have a high electric breakdown strength (E b), a large DP (P max - P r), and a delayed AFE-FE phase transition electric field [10, 11] spite extensive efforts to search for lead-free AFE ...

Antiferroelectric ceramics with different B-site ions valence states were prepared at an ultra-low sintering temperature of 900 °C. By introducing distortion at both the A-site and B-site, the structural symmetry is greatly delayed as the temperature increases, resulting in excellent energy storage performance in the ultra-wide temperature range of 25-200 °C.

Antiferroelectric materials, which exhibit high saturation polarization intensity with small residual polarization intensity, are considered as the most promising dielectric energy storage materials. The energy storage properties of ceramics are known to be highly dependent on the annealing atmosphere employed in their preparation. In this study, we investigated the ...

A synergistic approach is proposed to achieve state-of-the-art energy storage performance in antiferroelectric thin films, involving the engineering of nanoscale structural ...

Self-polarization and energy storage performance in antiferroelectric-insulator multilayer thin films. Author links open overlay panel Tiandong Zhang a b, Chao Yin a b ... For example, (32.6, 88.1%) represents the energy storage performance of PZO/AO/PZO films annealed at 550 °C. The comparison diagram of PZO/AO/PZO multilayer films with other ...

In this work, a record-high recoverable energy storage density W rec up to 9.0 J cm -3 and energy efficiency i of 90% are achieved in lead-free AgNbO 3-based ceramics ...

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