Antiferroelectric energy storage materials

Are antiferroelectric materials suitable for energy storage applications?
Antiferroelectric materials are attractive for energy storage applicationsand are becoming increasingly important for power electronics. Lead-free silver niobate (AgNbO 3) and sodium niobate (NaNbO 3) antiferroelectric ceramics have attracted intensive interest as promising candidates for environmentally friendly energy storage products.

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.

Which antiferroelectric ceramic systems are best for energy storage?
In this review, the current state-of-the-art as regards antiferroelectric ceramic systems, including PbZrO 3 -based, AgNbO 3 -based, and (Bi,Na)TiO 3 -based systems, are comprehensively summarized with regards to their energy storage performance.

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).

Are antiferroelectrics a good candidate for energy storage capacitors?
Provided by the Springer Nature SharedIt content-sharing initiative Antiferroelectrics (AFEs) are promising candidatesin energy-storage capacitors,electrocaloric solid-cooling,and displacement transducers.

Can lead-free antiferroelectric ceramics improve energy storage performance?
Meanwhile, recent progress on lead-free antiferroelectric ceramics, represented by AgNbO 3 and NaNbO 3, is highlighted in terms of their crystal structures, phase transitions and potential dielectric energy storage applications. Specifically, the origin of the enhanced energy storage performance is discussed from a scientific point of view.

Dielectric capacitors hold an enormous advantage for energy storage that requires a fast charging/discharging rate; but relatively low energy capacity is a key limitation ...

Antiferroelectrics (AFEs) are promising candidates in energy-storage capacitors, electrocaloric solid-cooling, and displacement transducers. As an actively studied lead-free antiferroelectric (AFE ...

Consequently, extensive research has been conducted on the energy storage capabilities of capacitors utilizing

ferroelectric 7-10 and antiferroelectric materials. 11,12 Due to their double hysteresis loops induced by phase transitions under electric fields, antiferroelectric (AFE) capacitors exhibit high energy storage densities and efficiency.

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 ...

Antiferroelectric materials have attracted growing attention for their potential applications in high energy storage capacitors, digital displacement transducers, pyroelectric detectors and sensors, solid-state cooling devices, and explosive energy conversion, and so on, because of their novel field-induced phase transitions between antiferroelectric and ferroelectric.

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 ...

AgNbO 3 (AN) and modified AgNbO 3 have been extensively investigated as promising lead-free antiferroelectric (AFE) energy storage materials. Previous studies have focused mainly on the use of an ion dopant at the A/B site to obtain a stabilized AFE phase; however, simultaneous improvements in the recoverable energy storage density (W rec) and efficiency (i) are still ...

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. Atomic-resolution transmission electron microscopy and X-ray reciprocal ...

Antiferroelectrics have received blooming interests because of a wide range of potential applications in energy storage, solid-state cooling, thermal switch, transducer, actuation, and memory devices. ... We hope this review can boost the development of antiferroelectric thin-film materials and device design, stimulating more researchers to ...

Antiferroelectric (AFE) materials are of great interest owing to their scientific richness and their utility in high-energy density capacitors. Here, the history of AFEs is reviewed, and the characte...

AgNbO3 lead-free antiferroelectric ceramic is reported to be a promising candidate for energy storage applications. A great breakthrough with high recoverable energy density up to 4.2 J cm-3 and good...

The development of antiferroelectric (AFE) materials with high recoverable energy-storage density (W rec)

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 (E ...

With an ever increasing dependence on electrical energy for powering modern equipment and electronics, research is focused on the development of efficient methods for the generation, storage and distribution of electrical power. In this regard, the development of suitable dielectric based solid-state capacitors will play a key role in revolutionizing modern day ...

AgNbO3 lead-free antiferroelectric (AFE) ceramics are attractive candidates for energy storage applications and power electronic systems. In this study, AgNbO3 ceramics are synthesized by single-step sintering (SSS) and two-step sintering (TSS) processes under oxygen-free atmosphere, and their energy storage performance is compared. The prepared ceramic ...

Various Pb-based antiferroelectric materials exhibit a typical double hysteresis loop and subsequently high discharge energy density. Ba 2+ is considered as the perfect substitute of Pb 2+ for energy storage applications. The benefit of Ba 2+ over Pb 2+ is that it changes the polar ordering and can consequently decrease the antiferroelectric to ferroelectric transition ...

A newly designed (Pb0.98La0.02)(Zr0.55Sn0.45)0.995O3 antiferroelectric ceramic exhibits an ultrahigh stored energy density of Ws = 11.9 J cm-3 and recoverable energy-storage density of Wrec = 10.4 J ...

Energy density as a function of composition (Fig. 1e) shows a peak in volumetric energy storage (115 J cm -3) at 80% Zr content, which corresponds to the squeezed antiferroelectric state from C ...

Field-driven transition from antiferroelectric (AFE) to ferroelectric (FE) states has gained extensive attention for microelectronics and energy storage applications. High dielectric ...

With the fast development of the power electronics, dielectric materials with large power densities, low loss, good temperature stability and fast charge and discharge rates are eagerly desired for the potential application in advanced pulsed power-storage system. Especially, antiferroelectric (AFE) capacitors which have been considered as a great potential for electric device ...

Among the dielectric materials, antiferroelectric (AFE) materials are recognized as their high energy storage performance owing to the large P max and small P r. 6,7 An essential feature of AFE materials is the electric field-induced reversible AFE to ...

Among the dielectric materials, antiferroelectric (AFE) materials have been showing superior energy storage density than the ferroelectrics (FE) and linear dielectric counterparts, since their characteristic electric field-induced AFE-FE transition and double P-E hysteresis loops endow them with large polarization in high-field FE phase and ...

The polarization response of antiferroelectrics to electric fields is such that the materials can store large energy densities, which makes them promising candidates for energy ...

Dielectric capacitors using antiferroelectric materials are capable of displaying higher energy densities as well as higher power/charge release densities by comparison with their ...

Antiferroelectric materials have shown potential applications in energy storage. However, controlling and improving the energy-storage performance in antiferroelectric remain ...