New materials with high energy storage density

Is ultrahigh recoverable energy storage density a bottleneck?
However,thus far,the huge challenge of realizing ultrahigh recoverable energy storage density (Wrec) accompanied by ultrahigh efficiency (i) still existed and has become a key bottleneckrestricting the development of dielectric materials in cutting-edge energy storage applications.

Does lead-free bulk ceramics have ultrahigh energy storage density?
Significantly,the ultrahigh comprehensive performance (Wrec ~10.06 J cm -3 with i ~90.8%) is realized in lead-free bulk ceramics,showing that the bottleneck of ultrahigh energy storage density (Wrec >= 10 J cm -3) with ultrahigh efficiency (i >= 90%) simultaneously in lead-free bulk ceramics has been broken through.

Do nanostructured storage devices increase capacitance density?
Nanostructured storage devices with 3D metal-insulator-metal (MIM) architectures--which require conformal metal and insulator deposition inside porous nanostructures--have successfully increased capacitance density,and therefore energy storage,per unit planar area (Fig. 3b,Supplementary Table 3).

Are KNN-based ceramics suitable for energy storage applications?
Although a large amount of KNN-based ceramics with high recoverable energy storage density (Wrec) have been designed for energy storage applications, the relatively low energy storage efficiency (i) limits their further development.

What is the energy density of dielectric materials?
We show that this allows for an energy density of 191.7 J/cm 3 with an efficiency greater than 90%. We believe our approach has the potential to enhance the performance of dielectric materials and be of use in other related applications that require high-energy storage systems.

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 Wrec values of 7.4, 8.2, and 12.2 J cm -3 in (K,Na)NbO 3 (KNN), BiFeO 3 (BF), and NaNbO 3 (NN)-based systems, respectively 7, 8, 9.

Rechargeable batteries of high energy density and overall performance are becoming a critically important technology in the rapidly changing society of the twenty-first century. While lithium-ion batteries have so far been the dominant choice, numerous emerging applications call for higher capacity, better safety and lower costs while maintaining sufficient cyclability. The design ...

Novel sodium niobate-based lead-free ceramics as new environment-friendly energy storage materials with high energy density, high power density, and excellent stability ACS Sustainable Chem. Eng., 6 (2018), pp.

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For linear dielectrics, the energy density (U e) equation is described as follows: (Equation 1) U e = 0.5 e 0 e r E b 2 where e 0 is the vacuum dielectric constant, e r is the relative dielectric constant and E b is the breakdown strength.The dielectric constant (e r) and breakdown strength (E b) are two key parameters to evaluate energy density.Polymer dielectrics with high ...

1 ??· The energy density of our device, 0.043 mWh cm? 2 calculated from the GCD curve (Figure S13, Supporting Information), offers a competitive balance between energy density ...

The secret to the successful and widespread deployment of solar energy for thermal applications is effective and affordable heat storage. The ability to provide a high energy storage density and ...

The reason behind lies in that the commercial Li +-ion battery materials have been primarily selected to match the high requirements on energy-storage performances, whereas the evolutionarily developed sustainable material alternatives usually have inherent drawbacks in terms of energy density, cycle stability, and cost competitiveness.

"Synthesized Sc 2 N 6, Sc 2 N 8, and ScN 5 solids are promising high-energy-density materials with calculated volumetric energy density, detonation velocity, and detonation pressure up to three ...

The performance of an energetic compound is mainly decided by parameters such as density, oxygen balance, heat of formation, and stability. Among these properties, density is the most important factor because it determines the detonation pressure and velocity. One of the trends in the development of high-energy-density materials (HEDMs) involves the study of ...

Despite their high theoretical energy density, conversion-type cathode materials face substantial challenges in practical applications. Fig. 1 depicts the conversion reaction of a conversion-type cathode material, taking FeS 2 as an example. The multi-electron reactions during charging and discharging provide superior specific capacity for such materials, which involves the repeated ...

For energy-related applications such as solar cells, catalysts, thermo-electrics, lithium-ion batteries, graphene-based materials, supercapacitors, and hydrogen storage systems, nanostructured materials have been extensively studied because of their advantages of high surface to volume ratios, favorable transport properties, tunable physical properties, and ...

Materials exhibiting high energy/power density are currently needed to meet the growing demand of portable electronics, electric vehicles and large-scale energy storage devices. The highest energy densities are achieved for fuel cells, batteries, and supercapacitors, but conventional dielectric capacitors are receiving increased attention for pulsed power ...

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Reaction materials with high energy storage density and low dissociation temperature are attractive. As a counter example, Silica gel, with required reaction temperature of lowing than 100 °C, has lower heat storage density than SHS materials, which makes it difficult to have a good application prospect. ... facing the need of new technologies ...

High energy storage density and low energy loss achieved by inserting charge traps in all organic dielectric materials ... c Electronic Materials Research Laboratory, ... This work offers a new strategy for the fabrication of all organic polymer dielectrics for realizing high discharged energy density and high discharging efficiency simultaneously.

Finding new high-energy-density materials with desired properties has been intensely-pursued in recent decades. ... indicating that thermal stability of ICM-102 was high enough for safe storage ...

The maximum energy storage density can be obtained for the sample with x = 0.10 at room temperature (RT), with an energy storage density of 2.04 J/cm 3 at 178 kV/cm, the performance of which is outstanding in lead-free ceramics. However, the energy storage efficiency is only around 55% [Citation 13]. Balancing of energy storage density and ...

K0.5Na0.5NbO3 (KNN)-based ceramics, as promising candidate materials that could replace lead-based ceramics, exhibit outstanding potential in pulsed power systems due to their large ...

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