

What is a polymer dielectric?

Nature Energy (2025) Cite this article Polymer dielectrics are the primary energy storage media in electrostatic capacitors, which are essential components in power electronics for electric vehicles and renewable energy systems.

Why are polymer dielectrics-based capacitors important?

Abstract: Polymer dielectrics-based capacitors are indispensable to the development of increasingly complex, miniaturized and sustainable electronics and electrical systems. However, the current polymer dielectrics are limited by their relatively low discharged energy density, efficiency and poor high-temperature performance.

What are the recent advances in polymer dielectric energy storage?

Recent progress in polymer dielectric energy storage: from film fabrication and modification to capacitor performance and application. Prog. Mater. Sci. 140, 101207 (2023). Yang, M., Zhou, L., Li, X., Ren, W. & Shen, Y. Polyimides physical-crosslinked by aromatic molecules exhibit ultrahigh energy density at 200 °C. Adv. Mater. 35, 2302392 (2023).

Does self-healing polymer dielectric exhibit ultrahigh capacitive energy storage performance?

Xu, W. et al. Self-healing polymer dielectric exhibiting ultrahigh capacitive energy storage performance at 250 °C. Energy Environ. Sci. 15, 12345 (2022).

What is a polymer composite capacitor?

The polymer composite capacitors comprehensively surpass state-of-the-art biaxially oriented polypropylene (BOPP) capacitors in terms of energy density, power density and capacitance stability at high temperatures, exhibiting broad application potentials.

Do gradient-layered polymer nanocomposites improve dielectric energy storage performance?

Wang, Y. et al. Gradient-layered polymer nanocomposites with significantly improved insulation performance for dielectric energy storage. Energy Storage Mater. 24, 626 (2019). Wang, H. Q. et al. Dielectric properties and energy storage performance of PVDF-based composites with MoS<sub>2</sub>@MXene nanofiller. Chem. Eng. J. 437, 135431 (2022).

Polymers are preferred dielectrics for high-voltage electrostatic capacitors owing to their inherent characteristics of high breakdown strength, graceful failure mechanism, self-healing ...

Here, we review the recent advances in the development of high-performance polymer and composite dielectrics for capacitive energy storage applications at both ambient and elevated ...

In this contribution, a class of semi-alicyclic dipolar glass dielectric polymers (sAI-DG) is developed, with an alternating non-conjugated alicyclic unit ...

Abstract Film capacitors based on polymer dielectrics face substantial challenges in meeting the requirements of developing harsh environment ( $\geq 150$  °C) applications. Polyimides have ...

This special property makes dielectric materials particularly useful in the context of electrical capacitor applications. Here, the dipole-electric field ...

Much effort has been invested for nearly five decades to identify and develop new polymer capacitor dielectrics for higher than ambient ...

Polymer dielectrics are key component for energy storage capacitors in modern electronical equipment with their high breakdown strength, great reliability and processable for large ...

Polymers are the preferred materials for dielectrics in high-energy-density capacitors. The electrification of transport and growing demand for advanced electronics require polymer dielectrics capable of ...

Dielectric capacitors can store energy by the displacement of bound charges, enabling rapid charging and discharging capability. In recent years, polymer-based dielectric capacitors have shown good ...

Polymer/conductive carbon particle composites have been studied for use in energy storage capacitors to achieve a strong dielectric response. Nevertheless, the robust percolation of ...

Here we report a molecular topology design for dielectric polymers with mechanical bonds that overcomes this obstacle, where cyclic polyethers are threaded onto the axles of various ...

Polymer dielectrics are the primary energy storage media in electrostatic capacitors, which are essential components in power electronics for ...

A polymer with high breakdown strength, low dielectric loss, great scalability, and reliability is a preferred dielectric material for dielectric capacitors. However, their low dielectric ...

Film capacitors are widely used in advanced electrical and electronic systems. The temperature stability of polymer dielectrics plays a ...

Ultrahigh-power-density metallized film capacitors at elevated temperatures and electric field extremes are key components in electrical and electronic systems. The miniaturization, ...

Aromatic polymer films with high glass transition temperatures ( $T_g$ ) exhibit superior thermal stability, making

them ideal for high-temperature ...

Film capacitors are essential components used for electrical energy storage in advanced high-power electrical and electronic systems. High temperature environments place ...

Dielectric capacitors can store energy by the displacement of bound charges, enabling rapid charging and discharging capability. In recent years, polymer-based dielectric capacitors have ...

Abstract Research on polymer-based dielectric materials with low energy loss and high power density for dielectric capacitors can promote the ...

Polymer dielectrics-based capacitors are indispensable to the development of increasingly complex, miniaturized and sustainable electronics and electrical systems. However, the ...

Conducting polymer based nanocomposites for supercapacitor applications: A review of recent advances, challenges and future prospects

Research focuses on electrostatic capacitors (dielectric capacitors), electrochemical capacitors, batteries, and solid oxide fuel cells, as shown in Fig. 1 [6]. Dielectric capacitors, with ultra ...

Dielectric capacitors have attracted ever-increasing interest in recent decades for numerous applications in modern electronic and electrical power systems due to their fast ...

Polymer-based dielectric capacitors are highly attractive to researchers because of their high  $E_b$ , low mass, stable structure, and good flexibility.

Abstract Research on polymer-based dielectric materials with low energy loss and high power density for dielectric capacitors can promote the development of advanced energy storage devices and ...

Polymers are key dielectric materials for energy storage capacitors in advanced electronics and electric power systems due to their high breakdown strengths, low loss, great ...

This review provides a comprehensive understanding of polymeric dielectric capacitors, from the fundamental theories at the dielectric material level to the latest developments for constructing ...

Beginning with the fundamental principles of dielectric materials and capacitor design, this review delves into key aspects such as material ...

In this review, recent progress in polymer-based multilayer-structure composite dielectrics based on multilayer interface engineering has been summarized, which includes charge ...

What are the disadvantages of supercapacitor technology? One of the major drawbacks of supercapacitors is their relatively low energy density, which hinders their widespread adoption in ...

A polymer solar cell-based photosupercapacitor is made by the integration of a polymer solar cell and a supercapacitor utilizing conducting polymers for energy harvesting and storage.

Abstract Dielectric capacitors can store energy by the displacement of bound charges, enabling rapid charging and discharging capability. In recent years, polymer-based dielectric ...

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