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[Skip to Main Content](#)

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## Patent Search

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**Abstract:**

The invention relates to a graphene-enhanced thermoelectric material designed to achieve high efficiency in energy conversion applications. The material comprises a thermoelectric matrix, such as bismuth telluride or lead telluride, with uniformly dispersed graphene nanostructures to optimize electrical conductivity and reduce phonon thermal conductivity, resulting in a significantly improved thermoelectric figure of merit (ZT). The invention includes a novel fabrication process involving liquid-phase exfoliation, ultrasonic dispersion, and controlled sintering to ensure homogeneity and stability. The material is suited for waste heat recovery, thermoelectric generators, and advanced cooling systems, offering enhanced performance, thermal stability, and mechanical strength.

**Complete Specification**

**Description:** This invention relates to the field of thermoelectric materials, specifically to graphene-enhanced thermoelectric composites designed for high-efficiency energy conversion. The invention focuses on materials and methods that achieve superior thermoelectric performance by leveraging graphene's exceptional electrical and thermal properties. These materials are particularly suited for applications in waste heat recovery, thermoelectric generators, and advanced cooling technologies.

**BACKGROUND OF THE INVENTION**

The following description of related art is intended to provide background information pertaining to the field of the disclosure. This section may include certain aspects of the art that may be related to various features of the present disclosure. However, it should be appreciated that this section be used only to enhance the understanding of the reader with respect to the present disclosure, and not as admissions of prior art.

Thermoelectric materials enable the direct conversion of heat energy into electrical energy through the Seebeck effect and vice versa through the Peltier effect. These materials have gained significant attention in the past decades for their potential applications in sustainable energy systems, waste heat recovery, and refrigeration. However, their widespread adoption is hindered by low thermoelectric efficiency, typically quantified by the dimensionless figure of merit (ZT).

Achieving a high ZT requires a delicate balance of electrical and thermal properties: high electrical conductivity, low thermal conductivity, and a high Seebeck coefficient. Traditional thermoelectric materials, such as bismuth telluride and lead telluride, have reached certain performance limits due to their intrinsic material properties, leaving minimal room for improvement using conventional approaches.

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