

What is thermal metamaterial?

The idea of thermal metamaterial has completely subverted the design of thermal functional devices and makes it possible to manipulate heat flow at ...Thermal metamaterialshave amazing properties in heat transfer beyond naturally occurring materials owing to their well-designed artificial structures.

How do thermal metamaterials and devices manipulate heat transfer?

In this Review,we discuss studies on various thermal metamaterials and devices in a unified framework,that of the manipulation of heat transfer through their unusual thermal conductivity and emissivity,which correspond to the two main forms of heat transfer: conduction and radiation.

Are thermal metamaterials relevant to electronic packaging?

This paper reviews recent advances of thermal metamaterials that are potentially relevantto electronics packaging. While providing an overview of the state-of-the-art and critical 2.5D/3D-integrated packaging challenges,this paper also discusses the implications of thermal metamaterials for the future of electronic packaging thermal management.

Are thermal metamaterials multifunctional?

However,the necessity for multifunctional design of metamaterials,encompassing both thermal and mechanical functionalities,is somewhat overlooked,resulting in the fixation of mechanical properties in thermal metamaterials designed within current research endeavors.

What can thermal metamaterials and photonic structures do for heat management?

With the deeper combination of thermal metamaterials and photonic structures, more booming developments will be promisingly achieved in this field. Based on transformation thermotics, functional thermal devices such as cloaks, concentrators, and rotators were designed. They are expected to play important roles in heat management.

What are the fundamental theories of thermal metamaterials?

To date,the fundamental theories of thermal metamaterials can be classified into two categories: macroscopic phenomenological theory and microscopic phononic/thermal photonic theory. The former contains transformation thermotics and its extended theories,whereas the latter is related with phononics and photonics.

Thermal energy storage (TES) is increasingly important due to the demand-supply challenge caused by the intermittency of renewable energy and waste heat dissipation ...

This study proposes multifunctional metamaterials possessing both load-bearing capacity and energy storage capability, comprising multi-phase lattice metamaterial and cylindrical battery ...

Thermal energy storage (TES) is a technology that reserves thermal energy by heating or cooling a storage medium and then uses the stored energy later for electricity generation using a heat engine cycle (Sarbu and Sebarchievici, 2018) can shift the electrical loads, which indicates its ability to operate in demand-side management (Fernandes et al., 2012).

It is always regarded as a drawback for thermal energy storage applications due to undesirable unstable and probabilistic performance - the higher the degree of supercooling, the lower the amount of latent heat that can be used 86. The ...

This chapter showcases three devices rooted in thermal metamaterials designed for conduction heat transfer: an energy-free thermostat utilizing temperature trapping theory with SMA; a groundbreaking negative-energy thermostat that produces electrical energy by merging thermotics with electricity; and a versatile multi-temperature ...

Thermal metamaterials exhibit thermal properties that do not exist in nature but can be rationally designed to offer unique capabilities of controlling heat transfer. Recent advances have demonstrated successful ...

Phase change materials (PCMs) have attracted tremendous attention in the field of thermal energy storage owing to the large energy storage density when going through the isothermal phase transition process, and the functional PCMs have been deeply explored for the applications of solar/electro-thermal energy storage, waste heat storage and utilization, ...

Here, a data-driven approach is proposed to design a thermal metamaterial capable of seamlessly achieving thermal functionalities and harnessing the advantages of ...

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