Phase change energy storage heat sink

The heat transfer characteristics of the widely used phase change material (PCM)-based heat sinks under hypergravity conditions are essential in the designation of the heat sink. The current study conducts a systematic evaluation on the thermal characteristics of PCM coupled with hybrid fin-metal foam (FMF) structure under variable hypergravity ...

The prevalent practice of integrating metal fins into phase change material (PCM) serves to enhance the thermal conductivity of PCM technology, which finds extensive utility in the efficient heat management of electronic devices. This study delves into the thermal behavior of an inclined heat sink that employs both the optimized tree-shaped and plate fins, each with ...

An optimal configuration of a rectangular enclosure with fins and a phase change material (PCM) based heat sink is determined to extend the safe operation time and keep the temperature of the electronic device in a safe range. The results show that the addition of fins has a significant impact on the heat transfer during the phase change of PCM ...

PCMs are energy storage materials capable of absorbing and releasing large quantities of energy isothermally. They have considerably large enthalpy of fusion and thermal energy storage densities compared to sensible heat [18].PCMs can virtually maintain constant temperature around the melting point owing to its high latent heat of fusion during the phase ...

research on void management during freeze/thaw transitions would benefit the design of phase change material (PCM) heat sinks for long-duration microgravity applications. ... thermal management or energy storage or are just important in manufacturing systems, and how to control nucleation for condensation. Since mobility in the solid is limited ...

This paper reports a heat sink that uses a composite phase change material (PCM) made from a copper foam infused with a Field"s metal eutectic alloy that melts at 60°C to achieve both high cooling and the ability to buffer transient temperature spikes. ... Review on thermal energy storage with phase change: materials, heat transfer analysis ...

The expression "energy crisis" refers to ever-increasing energy demand and the depletion of traditional resources. Conventional resources are commonly used around the world because this is a low-cost method to meet the energy demands but along aside, these have negative consequences such as air and water pollution, ozone layer depletion, habitat ...

To investigate the W-G-H composite properties as a heat sink coating, a ~1 mm thick W-G-H coating was applied at the back of the solar panel using the blade coating method. ... Thermal enhancement and shape stabilization of a phase-change energy-storage material via copper nanowire aerogel. Chem. Eng. J., 373 (2019), pp. 857-869, 10.1016/j ...

Some natural materials undergo phase shifts, and they are endowed with a high inherent heat storage capacity known as latent heat capacity. These materials exhibit this behavior due to the considerable amount of thermal energy needed to counteract molecular when a material transforms from a solid to a liquid or back to a solid.

Metal fin enhanced phase change material (PCM) has been successfully demonstrated as an effective approach for electronic devices cooling, especially in the case of high-power density for only a limited period. Application of PCMs in the heat sink accelerates the heat storage and reduces the heat rejection resulting in a tradeoff effect.

Heat transfer enhancement for thermal energy storage using metal foams embedded within phase change materials (PCMs) Sol. Energy, 84 (8) ... Optimization of a phase change heat sink for extreme environments, Anonymous, 2003, pp. 351-356. Google Scholar [37] Wakefield-Vette, Thermal Management: Standard Product Catalog, 2018. Google Scholar [38]

The findings revealed that the phase change material extends the heat sink"s working duration while adding nanoparticles improves performance. The performance of the phase change material and mixture of the nanoparticles was examined using a finned heat sink under constant heat input. ... Review on thermal energy storage with phase change ...

The highest enhancement ratio of ~2.97 is obtained at 1.3 and 2.7 kW/m 2 for four-finned MF-PCM heat sink and three-finned MF-PCM heat sink, respectively. Also, three-finned heat sink provides higher heat transfer rate and highest thermal conductance at q ? = 2.7 kW/m 2.

Designing effective thermal control modules in spacecraft is one of the prime concerns for space missions. 2D numerical simulations are carried out for investigating the melting process of paraffin wax as a phase change material (PCM) in microgravity conditions. Divided into three categories, a total of twelve different arrangements of heat source-sink pairs ...

Efficient thermal management has become an important challenge for the integration and miniaturization of electronic devices with high power density. Phase change material (PCM)-based finned heat sink is an efficient passive cooling technology for an intermittent-use electronic device with high power density. The present work reports an ...

Thermal management using phase change materials (PCMs) is a promising solution for cooling and energy storage 7,8, where the PCM offers the ability to store or release ...

Power Level Power requirement of the electronic device is the amount of heat dissipated to a great extent. In an experimental study done by Rehman et al. [], the heat loads were varied as 8 W, 16 W and 24 W by fixing the ambient conditions and volume fraction of the phase change material.They found that as power levels were increased the base temperature ...

The concept of the phase change material (PCM) based heat sink is based on the principle of latent heat thermal energy storage systems (LHTESS) where PCM absorbs and releases a large amount of thermal energy at the selected melting or freezing temperature range of the PCM [4], [5], [6]. However, the complete design for actual implementation is ...

One technique for stabilizing temperature fluctuations on TEG surfaces under transient thermal conditions is utilization of phase change material (PCM) [7] for its high thermal energy storage capacity as heat of fusion [8], [9]. In thermoelectric systems, PCM can be used on the cold side of a TEG as a heat sink [10].

Novel designs have been proposed for the phase change material (PCM) heat sink of concentrated photovoltaic (CPV) cells to enhance both convective and conductive heat transfer mechanisms. Trapezoid (with two different thickness ratios) and zigzag geometry designs are suggested for the CPV-heat sink. To enhance the performance, two improving treatments ...

The current thermal management technologies for electronic chips mainly include natural convection cooling [6], forced convection cooling [7], liquid cooling [8], heat pipe [9], the use of nanofluids [10], thermoelectric coolers [11] and phase change energy storage technology [12] is difficult for traditional natural convection cooling and forced convection cooling ...

In addition to demonstrating the feasibility of applying cascaded phase change technology in cross-seasonal heat storage heating, this study reveals the lifecycle sustainability ...

The improvement in cycling stability of bischofite as a thermal energy storage material was investigated by Gutierrez et al. . ... Kothari KR, Sahu SK, Kundalwal SI (2021) A comparative study and optimization of phase change material based heat sinks for thermal management of electronic components. J Energy Storage 43.

The current two-dimensional (2D) numerical study presents the melting phenomenon and heat transfer performance of the nanocomposite phase change material (NCPCM) based heat sink. Metallic nanoparticles (copper: Cu) of different volume fractions of 0.00, 0.01, 0.03, and 0.05 were dispersed in RT-28HC, used as a PCM. Transient simulations ...

o Thermal storage with liquid/vapor phase change often is superior with heat rejection with one -two applications per mission o Vapor is normally vented o Sublimators are often used in manned spacecraft during ascent and descent, when no external heat sink is ...

Transient performance of a thermal energy storage-based heat sink using a liquid metal as the phase change material Appl. Therm. Eng., 109 (2016), pp. 746 - 750 View PDF View article View in Scopus Google Scholar

Thermal energy storage (TES) systems containing phase change materials (PCMs) have been established as highly efficient components for transient cooling [1], [2] but are hindered by a lack of cohesive geometry and composition design guidelines, resulting in underperforming PCM structures developed through arbitrary or empirical methods.

This numerical study examines the thermal performance of solar photovoltaic (PV) with phase change material (PCM) as a heat sink under real ambient conditions. A mathematical model is ...

Latent thermal energy storages are using phase change materials (PCMs) as storage material. By utilization of the phase change, a high storage density within a narrow temperature range is possible. Mainly materials with a solid-liquid phase change are applied due to the smaller volume change. [13]

However, PCM as thermal energy storage (TES) media, such as paraffin wax, hydrated salt, molten salt, and so on, have low thermal conductivity, which significantly restricts the heat transfer rate and hence extends the energy charge/discharge cycle. ... explored the effects of metal foam pore density and porosity on the phase change thermal ...

In this study, a technique to improve the energy efficiency of thermoelectric cooling systems by minimizing its hot side temperature has been proposed. Computational studies were conducted by introducing phase change material in heat sink to study the effect of phase change material on the heat dissipation using ANSYS 18.1.

Thermal management of electronic devices and concentrator photovoltaic systems using phase change material heat sinks: experimental investigations. Renew Energy ... Numerical study on the effects of fins and nanoparticles in a shell and tube phase change thermal energy storage unit. Appl Energy, 216 (2018), pp. 142-156. View PDF View article ...