

Thermal management of electronic equipment and energy storage devices

What is electronic thermal management?

In the field of electronics thermal management (TM), there has already been a lot of work done to create cooling options that guarantee steady-state performance. However, electronic devices (EDs) are progressively utilized in applications that involve time-varying workloads.

Can thermal management systems be used in electronic devices?

This work undertakes a literature review of thermal management systems in different applications, such as mobile phones, laptops, data centers, electric vehicles, and aircraft, and then goes on to discuss the selection of the most suitable PCMs for use in the TMS of electronic devices.

What is the most common thermal management strategy for electronic devices?

Currently, the most common thermal management strategy toward electronic devices is to utilize heat conducting materials to dynamically remove the excessive heat in the operation units. Different materials have different heat conduction carriers due to different compositions and microstructures.

What is thermal management system?

Otherwise, the thermal management is called passive. Generally, a proper design of the thermal management system is crucial to achieve high dissipation rates and a uniform cooling, capable of ensuring stable temperature profiles inside the electronic device, .

What are the applications of thermal management systems?

Thermal management systems are crucial for the efficient operation of electronic devices and equipment, ranging from small and compact devices like mobile phones to larger equipment like aircraft. In section 1, five applications in which TMS play critical role were proposed: mobile phones, laptops, data centers, electric vehicles, and aircraft.

What is a thermal management system (TMS)?

Effective thermal management systems (TMS) are crucial for the optimal operation of electronic devices in computing, data centers, and transportation. This review begins by highlighting the essential role that TMS plays in today's electronics, where performance, reliability, and energy efficiency are of utmost importance.

Previously, passive cooling using phase change materials (PCMs) has been proposed as a thermal management method for electronic devices. In this work, a hybrid ...

The efficient thermal management of electronic devices is essential, considering overheating is harmful to the efficiency and reliability of electronic components. ... Multifunctional energy storage and conversion devices. Adv. Mater, 28 (2016), pp. 8344-8364. ... Experimental investigations on phase change material based finned heat sinks for ...

Recently, the thermal management of power electronic converters has gained significant attention due to the continuous trend of developing very compact power electronic converters with high power density. With the evolution of power semiconductor devices, high operating temperatures and large thermal cycles have become possible, necessitating a ...

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Improving Transient Performance in Thermal Energy Storage Units using Nearest Neighbor Search and ANNs [] improved the transient performance of thermal energy storage units using PCM for latent heat storage by thermal management by applying ML a phenomenon known as subcooling, the solidification of PCM is initialized by significantly reducing the ...

This paper presents a review on the TMTs for electronics in spacecraft environment based on heat transfer processes, including heat acquisition, heat transport, and heat rejection, as summarized in Fig. 2 Section 2, recent investigations on efficient heat acquisition are detailly discussed, including the utilization of high thermal conductance materials, development of ...

of thermal management in electronic devices, solutions and recommendations for effective cooling strategy, upcoming research methods and conclusion gives the summary of the electronic cooling.

Thermal management of electronic devices has attracted tremendous attention because of its importance in regulating the operation conditions of electronic devices under very high thermal loads. The most widespread thermal management technologies and solutions can be classified into two main categories: active and passive cooling [12].

Combining CNFs with high-thermal-conductivity fillers is an effective thermal management technique. This paper focuses on the thermal management of electronic devices and highlights the potential of CNF-based materials for efficient thermal management of energy storage electronic such as supercapacitors, lithium-ion batteries and solar cells.

All electronic equipment and energy storage devices generate excess heat and thus require thermal management to improve their reliability and prevent premature failure. Thermal ...

Basic concepts of thermal management. To address the growing cooling issue, it makes sense to review our understanding of the three ways in which thermal energy is transferred: conduction, convection and radiation. All ...

Thermal energy storage for heavy electronic equipment cooling applications. Several methods are adopted to

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reduce the temperature of heavy electronic equipments by removing heat from active devices. Thermal management of electronic equipment is rapidly growing research area, because, of electronic components failure due to overheating ...

The cold storage can be water storage or ice storage. The chiller-cooling tower system is connected to the cold storage and helps to provide extra cold energy to the storage water, when the capacity of the heat pipes is not enough. The downtime of the chiller equipment attributed to the cold energy storage system can save electricity cost.

It has been well documented that the shrinking size and escalating density of transistors and other integrated circuit devices over time has enhanced computing capabilities at the cost of increasing power dissipation across the device, die, and system levels [5], [6], [7]. The power required for high performance computing applications on some modern processor ...

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These higher power densities are generally localized and, thus, creates local thermal hot spots with values between 0.1-1 kW / cm² [3], which can lead to high local temperatures, often above the recommended thresholds [1], and large temperature gradients (e.g., 5 °C -30 °C) within the component [4]. Prolonged high temperature operations may ...

A host of high-voltage-capable electronic packaging approaches have emerged in recent years for usage in next generation power electronics. In this article, the focus is on the challenge of managing the thermal characteristics in these cutting edge packaging options, where power densities are exceeding 25 kW/L. Utilizing wide bandgap semiconductors like SiC and GaN ...

Abstract: Low-cost, high-performance thermal management technologies are helping meet aggressive power density, specific power, cost, and reliability targets for power electronics and electric machines. NREL is working closely with numerous industry and research partners to help influence development of components that meet aggressive performance and ...

Power semiconductors and chips are essential in modern electronics, driving applications from personal devices and data centers to energy technologies, vehicles, ...

Why is thermal management essential? Manage and dissipate heat Limit failure, increase reliability Increase power density . Transition to wide-bandgap (WBG) devices changes, but does not reduce, need for thermal management . WBG devices o More efficient Less heat o Yield and cost issues Smaller die sizes/Reduced area

In addition to the aforementioned open-loop cooling technologies, thermal regulation using PCMs has

emerged as a promising approach for passive thermal ...

Thermal management techniques for electronic devices are crucial to prevent overheating, extend the lifespan of components, and ensure reliable performance. This section briefly overviews various thermal management techniques and methods for various electronic devices. Fig. 4 Various factors affecting electronic failures

17.3.1 Thermal management of electronics using other fluids. The demand for storage of data has increased in recent years and is increasing day by day. It is challenging for electronic thermal management [29]. The result is the storage of data in compact and portable devices and this leads to the heating of that device due to improper thermal management of electronic components [30].

Jet impingement cooling is one of effective cooling methods with relatively low thermal resistance; and has widely been employed as thermal management solutions for power electronics devices and industry. A schematic diagram of distinction of air-jet impingement regions is shown in Fig. 9. The jet impingement cooling process is similar to ...

Thermal management of electronics systems is a major domain that applies suitable heat transfer technologies to cool the electronics systems. The current heat transfer ...

This Special Issue aims to provide a collection of the latest research and findings in the field of thermal management of electronic equipment and energy storage devices. Both research and review papers are welcome. Potential research topics include, but are not limited to, the following: (1) High/ultra-high heat flux dissipation;

Thermal management is crucial for the lifespan and safety of lithium-ion batteries, especially for the electrochemical energy storage which is composed of thousands of battery cells.

Review of the heat transfer enhancement for phase change heat storage devices. Author links open overlay panel Yunyun Xie a b, Jiaju Liu a, Wei Ma c, Jiang Sheng c, ... thermal management of electronic equipment, solar energy system and energy storage system. By investigating the literatures, it is found that the phase change heat storage ...

Energy. Volume 216, 1 February 2021, 119223. Thermal management and temperature uniformity enhancement of electronic devices by micro heat sinks: A review. Author links open overlay panel Ziqiang He a b, Yunfei Yan a b, Zhien Zhang c.

The status of research on the application of phase-change-materials for thermal management of electronic devices was investigated in this work. This review provides an ...

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The problem of heat dissipation has become a key to maintain the operation state and extending the service time of electronic components. Developing effective thermal management materials and technologies is of great significance to solve this problem. Previously, passive cooling using phase change materials (PCMs) has been proposed as a thermal ...

Thermal energy storage and management: Simple material preparation method: Low latent heat: ... The principle of the printing equipment used in the electronic package is shown in Fig. 1 a. The material needed for printing (70PW) is placed in the storage cylinder and heated to the molten state (the operating temperature is set to 100 ...

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