

Phase Change Material (PCM) Based Heat Sink with Volumetric Expansion Control



Technology Overview

The present invention relates to the assembly of a passive thermal management system, namely a phase change material (PCM) heat sink, which includes a mechanism to relieve the pressure within the chamber during the expansion of the phase change material.

The most common method of encapsulating PCM is to fill the chamber in its expanded state, i.e. liquid state, and seal. As the PCM cools and contracts, the capsule experiences a negative pressure. Another known method is to leave void air spaces in the capsule to allow for expansion; however this method reduces the contact surface area between the PCM and capsule wall, hence reducing thermal conductivity of the heat sink; also, it is not suitable for multi-directional mounting usage.

A way of improving thermal conductivity is to ensure a large contact surface area between the PCM and wall at all times. This cannot be achieved using the conventional method of PCM containment. Therefore, a method to accommodate the expansion of the PCM is implemented. This solves the problem of air voids in the heat sink and ensures a constant contact surface area between the PCM

Customer Benefits

Electronic and electrical devices such as battery cells and converters produce large amounts of heat during operation. A heat sink is often included in the system to aid in the removal of heat, typically by air or liquid cooling systems. In certain systems where cyclic loads are involved, PCM heat sinks are used.

Research Partner

Newcastle University International Singapore

Features & Specifications

A comparison study was conducted between a typical PCM based heat sink and the PCM based heat sink with volumetric expansion control. The typical PCM based heat sink has a 20% volumetric void space. An infrared thermal imager, fluke Ti400, was used to capture the surface temperature of the PCM based heat sink assembly while it was placed over a constant heated surface of 50 degrees Celsius. The fastening system employed by the PCM based heat sink with volumetric expansion control allows a constant contact between all faces of the heat sink, hence, a larger surface area for heat transfer to occur. The invention has successfully eliminated the requirement of accommodating a void space for thermal expansion, and at the meantime, successfully maintained a constant contact interface between the PCM and heat sink walls.

Potential Applications

This PCM based heat sink can be used as the cooling system for

- Underwater system;
- Deep-sea power system;
- Electric vehicle; and
- Electric converter.