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Investigation on Phase Change Device for Satellite Thermal Control

Authors : Meng-Hao Chen, Jeng-Der Huang, Chia-Ray Chen

Abstract : With the new space mission need of high power dissipation, low thermal inertia and cyclical operation unit, such as high power amplifier (HPA) for synthetic aperture radar (SAR) satellite, the development of phase change material (PCM) technology seems to be a proper solution. Generally, the expected benefit of PCM solution is to eliminate temperature variation and maintain the stability of electronic units by using the latent heat during phase change process. It can also result in advantages of decreased radiator area and heater power. However, the PCMs have a drawback of low thermal conductivity that leads to large temperature gradient between the heat source and PCM. This paper thus presents both experimental and simplified numerical investigations on configuration design of PCM's container. A comparison was carried out between the container with and without internal pin-fins structure. The results showed the benefit of pin-fins that act as the heat transfer enhancer to improve the temperature uniformity during phase transition. Furthermore, thermal testing and measurements were presented for four PCM candidates (i.e. n-octadecane, n-eicosane, glycerin and gallium). The solidification and supercooling behaviors on different PCMs were compared with available literature data and discussed in this study

Keywords : phase change material (PCM), thermal control, solidification, supercooling
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