Enhancement of Transient Heat Transfer of Phase Change Material for Electronics Cooling and Energy Storage

Shibin "Joey" Liang – Senior Design Engineer NEDC – Aavid Corporation, Laconia, NH

E-Mail: liang@aavid.com

Abstract

Applying phase change materials in heat sinks to absorb transient or intermittent heating load from electronics especially moveable devices has attracted attentions of many engineers and researchers. In the application of energy storage, phase change materials are also widely recognized and applied. Because of the poor thermal conductivity of a phase change material, how to design a highly efficient and cost-effective heat sink is really a challenge or even critical to the success of this type of application. In this investigation, a heat sink filled with paraffin wax was built and tested under transient heating loads. The efficiency of heat sink was studied via selecting its different inner structures. Testing results have shown that the difference between copper and aluminum as material of inner structures or fins on the performance of heat sink was negligible. Reducing the porosity of inner structures of heat sink can significantly enhance its performance especially under a transient heating load. Different types of metal foam as inner fins were investigated via testing. Experimental results have demonstrated that there is the longest length of heat penetration related to a certain transient heating load. Otherwise extra phase change materials such as paraffin wax are no help for the absorption of energy or without responses due to their poor thermal conductivity. Numerical simulation in Ansys Icepak was also performed and its results were compared with experimental results. Optimization of the design of new phase change material heat sinks based on modified models was recommended. Ansys mechanical was also used to investigate the expansion of wax on the structure of case/box of phase change material heat sink.