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ABSTRACT

Thermally conductive composites as compared to metals have reduced density, decreased oxidation, and improved chemical resistance, as well as adjustable properties to fit a given application. However, there are several challenges that need to be addressed before they can be successfully implemented in heat sink design. The interface between the device and heat sink is an important factor in the thermal design of microelectronics cooling. Depending on the thermal interface conditions and material properties, the contact pressure and thermal stress level can attain undesirable values. In this paper, we investigate the effect of thermal interface between the fin and base plate on thermal-structural behavior of heat sinks. A coupled-field (thermal-structural) analysis using finite element method is performed to predict temperature as well as stress fields in the interface region. In addition temperature and heat flow rate predictions are supported through analytical results. Effect of various interface geometrical (such as slot-depth, axial-gap and radial-gap) and contact properties (such as air gap with surface roughness and gaps filled with interface material) on the resulting thermal-structural response is investigated with respect to four interface materials combinations, and it is found that the thermal performance is most sensitive to the slot-depth compared to any other parameter.

KEYWORDS Pin fin, Finite element analysis, Orthotropic material, Composite material, Heat sink, Electronic cooling