Contribution ID: **30** Type: **not specified**

Heat Transfer Interface to Graphitic Foam

Tuesday, 26 June 2018 11:45 (30 minutes)

Thermal interface materials (TIMs) used for bonding components are important for creating a thermal conductive path which improves heat dissipation. Low density, porous carbon foams are commonly used for thermal management applications and devices. Their high surface area to volume ratio enables cooling more effectively via different heat transfer methods. Many studies have adopted different methods to analytically or computationally analyze the effective thermal conductivity of carbon foams. Others have studied the participation of TIMs used in composite materials. However, very few studies have analyzed the microscale effects of the interaction between TIM and carbon foams. The amount of contact between a carbon foam and a bonded surface has hardly been reported in the literature. In this study, a glassy graphitic foam developed by AllComp Inc. was used as a precursor. Graphene's highly anisotropic thermal properties result in high thermal conductivity in the planar direction, while low in the normal direction. With these anisotropic thermal characteristics, it is interesting to determine how varying TIM thickness optimizes for thermal conductivity. It is hypothesized that the direction where heat enters the graphitic foam and the size of the cross-sectional area normal to the heat flux direction would affect the overall effective thermal conductivity. Furthermore, a gap created between ligands and the bonded surface would likely reduce it. A computational model using ANSYS finite element program was developed in this study. Incorporating TIMs in the finite element model, the effective thermal conductivity is found to increase by 2.9% to 20% depending on the filler types and its thickness. With ligands at the interface removed, the effective thermal conductivity decreases by -8.5% to -40%. The results demonstrate that the parameters at the interface can be optimized to improve the overall effective thermal conductivity of the interface.

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