World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:8, No:11, 2014

Optimization of Double-Layered Microchannel Heat Sinks

Authors : Tu-Chieh Hung, Wei-Mon Yan, Xiao-Dong Wang, Yu-Xian Huang

Abstract : This work employs a combined optimization procedure including a simplified conjugate-gradient method and a three-dimensional fluid flow and heat transfer model to study the optimal geometric parameter design of double-layered microchannel heat sinks. The overall thermal resistance RT is the objective function to be minimized with number of channels, N, the channel width ratio, β, the bottom channel aspect ratio, αb, and upper channel aspect ratio, αu, as the search variables. It is shown that, for the given bottom area (10 mm×10 mm) and heat flux (100 W cm-2), the optimal (minimum) thermal resistance of double-layered microchannel heat sinks is about RT=0.12 ℃/m2W with the corresponding optimal geometric parameters N=73, β=0.50, αb=3.52, and, αu= 7.21 under a constant pumping power of 0.05 W. The optimization process produces a maximum reduction by 52.8% in the overall thermal resistance compared with an initial guess (N=112, β=0.37, αb=10.32 and, αu=10.93). The results also show that the optimal thermal resistance decreases rapidly with the pumping power and tends to be a saturated value afterward. The corresponding optimal values of parameters N, αb, and αu increase while that of β decrease as the pumping power increases. However, further increasing pumping power is not always cost-effective for the application of heat sink designs.

Keywords : optimization, double-layered microchannel heat sink, simplified conjugate-gradient method, thermal resistance
Conference Title : ICCSO 2014 : International Conference on Computational Sciences and Optimization
Conference Location : Kyoto, Japan
Conference Dates : November 13-14, 2014