

UNIVERSITI TEKNOLOGI MARA

**THERMAL PERFORMANCE OF
Al₂O₃-Cu/WATER HYBRID
NANOFLUID IN MINI-CHANNEL
WITH PIN FINS HEAT SINK**

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MSc

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ABSTRACT

Compact electronic devices require good thermal management system. However, the conventional cooling method is no longer efficient to remove heat and overcome the overheating problems. The objectives of this study are to design an innovative mini channel heat sink with micro pin fins with better thermal characteristics and to analyze the effect of velocity with different concentration of coolant on the performance of the mini channel heat sink were successfully achieved. A mini channel integrated with micro pin fins was simulated in this present study. The selected hybrid nanofluid for this study is Al_2O_3 -Cu/water hybrid nanofluid with concentrations varying from 0.1%, 0.2% and 0.3% with the ration of 90:10. The Reynolds number used for this study ranges between 100 to 200. 50 W of heat input is supplied to the heat sink. The unfinned mini channel was compared to the finned mini channel to prove that the integration of the pin fins on the mini channel gives better heat transfer performance. The heat transfer coefficient achieved by the unfinned mini channel is 4843.621 $\text{W}/\text{m}^2\cdot\text{K}$ and the heat transfer coefficient of the finned mini channel gives the value of 6195.723 $\text{W}/\text{m}^2\cdot\text{K}$. Next, even though only small gap of Reynolds number were investigated, there were certain improvement by the 0.3 % Al_2O_3 -Cu/water hybrid nanofluid compared to the base fluid. For instance, when Reynolds number is at 200, the heat transfer coefficient of 0.3 % Al_2O_3 -Cu/water hybrid nanofluid has the value of 8954.205 compared to water which has the value of 8923.15. Other than that, when Reynolds number is at 200, the thermal resistance of 0.3 % Al_2O_3 -Cu/water hybrid nanofluid has the value of 2.343 K/W compared to water which has the value of 2.352 K/W . Next, as the Reynolds number is at 200, the value of the Nusselt number for 0.3 % Al_2O_3 -Cu/water hybrid nanofluid is around 12.379 meanwhile the value of Nusselt number for water is around 12.336. Thus, adding the micro pin fins on the mini channel is definitely increasing the thermal performance of the system. Then, 0.3 % Al_2O_3 -Cu/water hybrid nanofluid works the best among others with maximum performance throughout all simulations.

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