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Optimization of thermal resistance of stacked micro-channel using genetic algorithms

Abstract

Purpose - To determine the optimal dimensions for a stacked micro-channel using the genetic algorithms (GAs) under different flow constraints. Design/methodology/approach - GA is used as an optimization tool for optimizing the thermal resistance of a stacked micro-channel under different flow constraints obtained by using the one dimensional (1D) and two dimensional (2D) finite element methods (FEM) and by thermal resistance network model as well (proposed by earlier researcher). The 2D FEM is used to study the effect of two dimensional heat conduction in the micro-channel material. Some parametric studies are carried out to determine the resulting performance of the stacked micro-channel. Different number of layers of the stacked micro-channel is also investigated to study its effect on the minimum thermal resistance. Findings - The results obtained from the ID FEM analysis compare well with those obtained from the thermal resistance network model. However, the 2D FEM analysis results in lower thermal resistance and, therefore, the importance of considering the conduction in two dimensions in the micro-channel is highlighted. Research limitations/implication - The analysis is valid for constant properties fluid and for steady-state conditions. The top-most surfaces as well as the side surfaces of the micro-channel are considered adiabatic. Practical implications - The method is very useful for practical design of micro-channel heat-sinks. Originality/value - FEM analyses of stacked micro-channel can be easily implemented in the optimization procedure for obtaining the dimensions of the stacked micro-channel heat-sinks for minimum thermal resistance.

Keywords — Finite element analysis, optimization techniques, thermal resistance