Fast transient solution of a two-layered counter-flow microchannel heat sink

Purpose: The purpose of this paper is to apply asymptotic waveform evaluation (AWE) to the transient analysis of a two-layered counter-flow microchannel heat sink. Design/methodology/approach: A two-layered counter-flow microchannel heat sink in both steady state and transient conditions is analysed. Finite element analysis is used in the steady state analysis whereas AWE is used in the transient analysis. Findings: A two-layered microchannel produces different temperature distribution compared to that obtained for a single-layered microchannel. The maximum temperature occurs at the middle of the bottom wall whereas the maximum temperature of a single-layered microchannel is at the outlet of the bottom wall. The time taken to reach steady state is also investigated for different coolant flow rate and heat flux boundary conditions. It is observed that when fluid velocity increases, the time taken to reach steady state decreases, however, when the heat flux increases, the time taken to reach steady state does not change. Research limitations/implications: The fluid is incompressible and does not undergo phase change. The use of AWE provides an alternative method in solving heat transfer problem. Practical implications: New and additional data will be useful in the design of a microchannel heat sink for the purpose of cooling of electronic components. Originality/value: AWE is widely used in analyses of signal delays in electronic circuits, and rarely applied to mechanical systems. The present study applies AWE to heat transfer problems, and reveals that it reduces the computational time considerably. The results obtained are compared with conventional methods available in the literature, and they show good agreement. Hence the computational time is reduced, and the accuracy of results is verified.