CFD MODELLING ON LIQUID-LIQUID SLUG FLOW HEAT TRANSFER IN MICROCHANNELS

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ABSTRACT

This paper will present the findings of numerical studies of liquid-liquid two-phase flow heat transfer in microchannels. The use of microchannels has found a wide range of industrial applications due to their high surface area to volume ratio. Some of these include heat exchangers, micro-reactors, microelectronics, and micro-electro-mechanical systems. Among these, two-phase flow in microchannels for electronic cooling has gained an increasing interest among researchers due to high demand for removing increased heat fluxes in miniaturized electronic devices.

Two-phase flow can be either boiling or non-boiling. Non-boiling two-phase flow has been popular due to its simplicity of production at standard flow conditions and inherent stability compared to boiling two phase flow. This flow can be generated using two non-mixing gas and liquid or from two non-mixing liquids. Studies in the literature have shown that liquid-liquid two-phase flow can remove higher heat fluxes compared to gas-liquid two-phase flow due to high heat capacity values of liquids [1]. Thus, this study will focus on liquid-liquid two-phase flow in microchannels.

The heat transfer rates associated with slug flow are increased significantly due to the internal circulations of fluids within liquid slugs. The amount of heat absorbed from slug flow in microchannels is dependent on the flow parameters such as capillary number, slug length, contact angle, and film thickness. Therefore, the effect of flow parameters on heat transfer is studied numerically using volume of fluid (VOF) method in ANSYS Fluent. The studies were carried out on a 100µm circular microchannel using 2D axisymmetric geometry configuration. The numerical results showed a significant increase in heat transfer rates of up to 300% compared to its single phase counterpart. The study also found a strong effect of flow parameters on heat transfer rates and a comprehensive discussion on that will be presented in the paper.

REFERENCES