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Volume-Of-Fluid Simulation for Predicting Two-Phase Cooling in a Microchannel CATHERINE GORLE, Stanford University, PRITISH PARIDA, IBM Watson Research Center, FARZAD HOUSHMAND, MEHDI ASHEGHI, KENNETH GOODSON, Stanford University — Two-phase flow in microfluidic geometries has applications of increasing interest for next generation electronic and opto-electronic systems, telecommunications devices, and vehicle electronics. While there has been progress on comprehensive simulation of two-phase flows in compact geometries, validation of the results in different flow regimes should be considered to determine the predictive capabilities. In the present study we use the volume-of-fluid method to model the flow through a single micro channel with cross section 100 x 100 μm and length 10mm. The channel inlet mass flux and the heat flux at the lower wall result in a subcooled boiling regime in the first 2.5mm of the channel and a saturated flow regime further downstream. A conservation equation for the vapor volume fraction, and a single set of momentum and energy equations with volume-averaged fluid properties are solved. A reduced-physics phase change model represents the evaporation of the liquid and the corresponding heat loss, and the surface tension is accounted for by a source term in the momentum equation. The phase change model used requires the definition of a time relaxation parameter, which can significantly affect the solution since it determines the rate of evaporation. The results are compared to experimental data available from literature, focusing on the capability of the reduced-physics phase change model to predict the correct flow pattern, temperature profile and pressure drop.

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