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Numerical Modelling of Phase-change: Application to Evaporating Taylor Bubbles in Superheated Rectangular Microchannels[1] YAN DELAURE, Dublin City University, THOMAS ABADIE, OMAR MATAR, Imperial College London — In micro-structured devices, the high surface to volume ratio leads to enhanced transport phenomena and the design of micro heat-exchangers requires some fundamental understanding on the dynamics and transfer phenomena taking place. The present study therefore aims at presenting a simple but accurate continuous model for modelling phase change in microfluidic devices within a finite volume Navier-Stokes flow solver. The proposed model is based on a Level Set method for capturing the interface on a fixed structured cartesian mesh and a continuous surface force method for the capillary force. The temperatures are solved in each phase in a sharp way in order to estimate the temperature gradients and the interfacial heat flux accurately. The accuracy of the phase change model is assessed with the analytical solution of the growth of a bubble in a superheated liquid. The evaporation rate of bubbles in superheated rectangular microchannels is investigated in the liquid film regime and the effects of geometry (aspect ratio) are studied. The effects of liquid superheat and operating conditions and thereby liquid film and thermal boundary layer thicknesses are discussed in terms of wall and interfacial heat fluxes.

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