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Numerical study of the bubbly flow regime in micro-channel flow boiling. PRAMOD BHUVANKAR, SADEGH DABIRI, Purdue University — Two-phase flow accompanied by boiling in micro-channel heat sinks is an effective means for heat removal from computer chips. We present a numerical study of flow boiling in micro-channels with conjugate heat transfer with a focus on the bubbly flow regime. The bubbles are assumed to nucleate at a pre-determined location and frequency. The Navier Stokes equations are solved using a single fluid formulation with the Front tracking method. Phase change is implemented using the deficit in heat flux across the bubble interface. The analytical solution for bubble growth in a superheated liquid is used as a benchmark to validate the mentioned numerical method. Water and FC-72 are studied as the operating fluids in a micro-channel made of Copper with a focus on hotspot mitigation. The micro-channel of cross-section $231\mu m$x$1000\mu m$, is used to study the effects of vertical up-flow, vertical down-flow and horizontal flow of the mentioned fluids on the heat transfer coefficients. A simple film model accounting for mass and energy conservation is applied wherever the bubble approaches closer than a cell width to the wall. The results of the simulation are compared with existing experimental data for bubble growth rates and heat transfer coefficients.

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