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Three-Dimensional Simulation of Vapor Bubble Dynamics in Nucleate Boiling DAMIR JURIC, GRETAR TRYGGVASON, Worcester Polytechnic Institute, SEUNGWON SHIN, Hongik University, Seoul, South Korea — The ability to apply numerical simulation to three-dimensional multiphase flows has existed now for nearly two decades. However, only in the last 2 or 3 years has this technology advanced into the realm of boiling flows. The difficulties inherent when computing solutions to these flows lie in the fact that not only do we need to accurately incorporate the usual physics of fluid flow, surface tension and deformable interfaces found in multiphase flows but now with boiling and phase change these must be coupled to the thermal transport and latent heat at the vaporizing or condensing interface. In addition, any simulation for real fluids and systems such as water must be prepared to handle the specific volume ratios and thus large volume expansions upon vaporization (1600 to 1 for water at standard conditions). In our numerical investigations we couple an explicit front tracking of the liquid-vapor interface with an advanced interface reconstruction technique and wall-refined grids to obtain high accuracy three-dimensional simulations of the large scale dynamic behavior of water vapor bubbles in nucleate boiling from active surface nucleation sites. We compare the overall heat transfer as a function of wall superheat to existing correlations and discuss various models for heat transfer in the microlayer and contact line.

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