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# Direct Numerical Simulation of single bubble dynamics in nucleate pool boiling with micro-region modeling and thermal coupling to a solid wall

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In this study, we perform two-dimensional, axisymmetric simulations to investigate the growth and departure of a single bubble, with a particular focus on the conjugate heat transfer between the fluid and the heating wall. A multiscale modeling approach is employed to account for nanoscale effects near the liquid-vapor-solid triple contact line (CL). At the macro scale, the interface dynamics are captured using the front-tracking method with the open-source code TRUST/TrioCFD. This macro scale algorithm is coupled with a sub-grid micro-region model, driven by the wall superheating at the CL, which predicts the macroscopic apparent contact angle and heat fluxes.

To validate our modeling approach, we conduct quantitative comparisons using data from the RUBI experiment and simulation results from pioneering work. Subsequently, the boiling cycle is simulated with our model. Notably, significant temperature variations near the nucleation site during bubble expansion and contraction affect the thermal boundary layers in both fluid and solid domains, highlighting the need to resolve conjugate heat transfer in simulated cases.

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