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# Diffuse Interface Method for Nucleate Boiling Simulations

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## Extended Abstract

Boiling is an efficient mechanism for heat transfer in several industrial applications due to its excellent heat transfer coefficient. The non-equilibrium thermodynamics, raised by the complex coupling of the heat and mass transfer in phase-change and surface processes, makes these systems difficult to describe accurately.

However, relevant developments have been made in computational methods enabling a detailed study of nucleate boiling phenomena with high performance parallelised numerical simulations based on different numerical methods.

We are developing a direct numerical simulation framework using our in-house TPLS solver [1] applying the diffuse interface method [2] which solves the Cahn-Hilliard equation to describe evolution of the liquid-vapour interface. This method removes the stress singularity at three-phase contact line and consequently enables to prescribe the surface wettability via contact-angle boundary conditions [3]. We are thus able to analyse the role of surface wettability on nucleate boiling heat transfer coefficient, bubble growth and departure.

The growth rates and departure of nucleating single bubbles have been obtained through simulations as a function of substrate wettability. The modelling framework has also been extended to simulate multiple bubbles to analyse the bubble interaction, the superheat and bubble size for different wettabilities.

Our simulation results show the importance of surface tension on the departure conditions, suggesting a better heat removal in high wettability cases. Conversely, we have found a limited growth rate in low wettability surfaces, which might promote the growth of subsequently forming bubbles.

## References

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