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NUMERICAL SIMULATION OF BUBBLE GROWTH UNDER LOW PRESSURE

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In the context of global warming, working fluids of air conditioners or heat pumps are harmful for climate and active research is ongoing to find replacement solutions. A potential candidate is to use water as working fluid. But to evaporate at ambient temperature at which air conditioners operate working pressure must be very low, around hundredth of atmospheric pressure. Apart from mechanical design and processing issues at this subatmospheric pressure, these heat exchangers experience inefficiency due to the lack of understanding of boiling phenomena at low pressure as usual correlations at atmospheric pressure are no more valid. Experimental studies are scarce while numerical simulations are inexistent on the subject to help build new correlations.

Phase change is a complex phenomenon involving multi-physics and multi-parameters and is more complex at low pressure since the hydrostatic pressure can no longer be neglected compared to the interface pressure. In these conditions a boiling bubble can grow up to 15 centimetres in height and be subjected to very heterogeneous conditions on its interface which affects bubble shape and growth. Many other parameters (pressure, temperature, etc.) could impact bubble along its lifetime and are difficult to control in experiments.

We propose to use direct numerical solver to give some insights while simplifying the problem. An in-house two-fluids compressible solver based on an accurate low-Mach numerical scheme [1] will be employed to consider hydrodynamical aspect of bubble growth.

First we will consider the dilatation of an isothermal gas inclusion at low pressure under a free-surface. Good qualitative reproducibility of experimental results (with phase change, ignored in simulations) will be shown.

Then phase change model build on instantaneous thermodynamical and mechanical relaxation [2] will be added. Influence of this model on bubble growth will be assessed against experimental results.

REFERENCES

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