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GROWTH AND DEPARTURE OF A SINGLE BUBBLE IN NUCLEATE BOILING REGIME

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ABSTRACT

The numerical simulation of the intricate phenomenon of nucleate boiling has been attempted in the present work. The growth and departure of a single bubble from a heated surface is observed with a focus to study the rate of bubble growth, departure time and the variation in heat transfer characteristics at the wall. The surrounding liquid around the growing bubble is superheated due to heat conduction from the heated surface which plays a major role in the evaporation at the liquid-vapour interface. The phenomenon is affected significantly by the amount of wall superheat and the surface property. Determining the effects of various degrees of wall superheat and change in contact angle of the liquid-vapour interface is therefore an important part of the present study. Son et al. [1999] explained the included dynamics of single bubble growth in nucleate boiling using the results from their numerical simulations.

The interface capturing technique in the present work follows CLSVOF (Combined Level Set and Volume of Fluid) algorithm (Gerlach et al. [2006]). The already developed interface capturing technique had been successfully applied in the simulation of film boiling phenomenon (Tomar et al. [2009], Pandey et al. [2016]). The present work is an attempt to extend the work to simulation of nucleate boiling regime. The heat flux due to evaporation of the liquid micro-layer underneath the growing bubble is calculated based on the micro-layer model by Sato and Niceno [2015]. Figure 1 shows the nucleation and growth of a vapor bubble on a solid substrate at different time instants.

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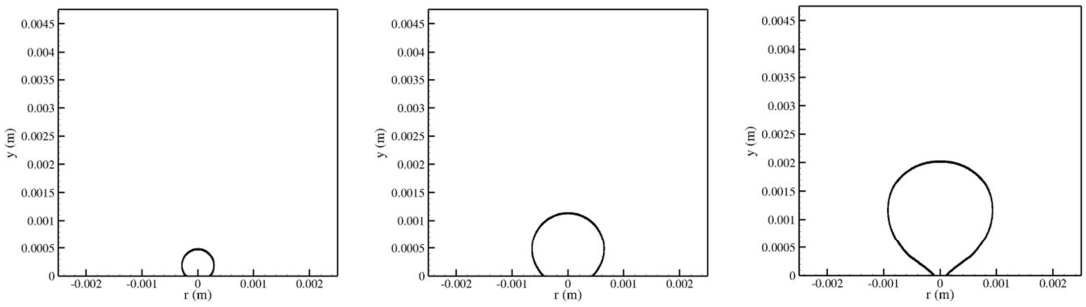

(a) (b) (c)

Fig 1. Growth of a vapor bubble over a solid wall with time.