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SINGLE BUBBLE POOL BOILING IN DIFFERENT GRAVITY LEVELS: NUMERICAL SIMULATIONS FOR PREPARATION OF THE PROJECT SOBER-SJ10

Abstract

A project SOBER-SJ10 has been proposed to study local convection and heat transfer around an isolated growing vapor bubble during nucleate pool boiling in microgravity aboard the Chinese recoverable satellite SJ-10, which will be launched in the end of 2015 or in the beginning of 2016. As a part of the preparation, numerical simulation of single bubble pool boiling is used to simulate this phenomenon in the present paper. Local convection and heat transfer around a single vapour bubble which is growing from a nucleus bubble planted artificially in bulk saturated liquid FC-72 on the surface of heaters with different thicknesses, as well as transient heat conduction inside the heater's wall, are simulated numerically with sharp interface representation. It's found that the thermal response of wall is found to affect the bubble growth and boiling heat transfer. During the process of bubble growth, a sharp temperature drop inside the solid wall is evident near the contact line underneath the growing bubble because of the strong evaporation in micro-region. The temperature and heat flux profiles change with the move of the contact line, and twice sharp temperature drops at a certain location are observed, which correspond to the expanding and recoiling processes, respectively. During the waiting period after the bubble detached from the wall, the temperature field is recovered by heat conduction inside the solid wall. The present numerical results reveal that the transient heat conduction inside the solid wall will be independent of the wall thickness if it is larger than some critical value. The fluctuation of temperature inside the solid wall will limited in a thin layer underneath the growing vapor bubble, while in the other part of the solid wall a quasi-one-dimensional steady heat conduction exists due to high conductibility of the solid wall. It's also found that the critical thickness increases with the decrease of gravity. And thus, a suitable thickness ought to be chosen for the space experiment.