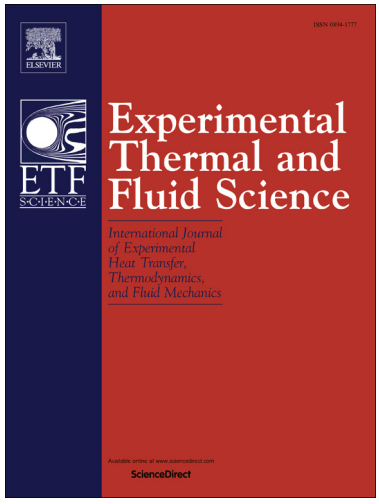

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Experimental study of bubble dynamics of isolated bubbles in water pool boiling at subatmospheric pressures

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Abstract

The purpose of this work is to expose specific features of bubble dynamics in water pool boiling at low pressure in comparison with the atmospheric pressure. At subatmospheric pressures, the boiling environment is known to be very non homogeneous, both in terms of pressure and subcooling degree. As a consequence, thermophysical properties of the fluid are not homogeneous either. These non homogeneities are supposed to be responsible for the particular shape, size and departure frequency of bubble observed at low pressure.

Experiments of water pool boiling were conducted at saturation state from atmospheric pressure ($T_{sat} = 100\ °C$) down to 4.2 kPa ($T_{sat} = 30°C$) with a single imposed heat flux at the heater. Videos of each experiment were recorded with a high speed camera in order to analyze the bubble dynamics for different pressures.

Increases of the bubble size and of the detachment frequency are observed as the pressure decreases while the bubble shape changes: a near-spherical shape at atmospheric pressure to an oblate spheroidal shape in the lowest investigated pressure range through a mushroom shape and/or vapor columns due to the rapid growth of successive bubbles sucked into the wake of the first one in the range of intermediate pressures. Recondensation of bubbles occurs rapidly after departure because of the subcooling degree. A home-made image processing software allowed calculating some quantitative parameters of the bubble dynamics such as the instantaneous volume and the departure frequency from the video records.

Keywords: Water pool boiling, subatmospheric pressure, bubble dynamics

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