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LETTER TO THE EDITOR

A PROPOSAL FOR A NEW EXPERIMENTAL INVESTIGATION ON THE VAPOR BUBBLE GROWTH DYNAMICS

M. D. RISTIĆ

Faculty of Mechanical Engineering, Beograd

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The aim of this letter is to describe the basic idea and a corresponding apparatus which is actually under construction.

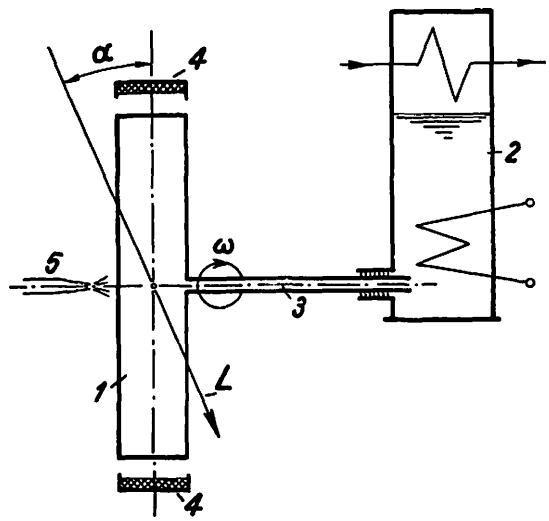
The conditions for the appearance of homogenous nucleation (which precedes the vapor bubble rise) as well as the anomalies which may accelerate or slow down the rate of nucleation, are as of yet insufficiently understood[1, 2, 3].

In order for the study of the homogenous nucleation and growth of a single bubble to be possible, the expansion of the classical thermodynamic method by expressing the velocity, temperature and density fields as functions of time is needed. Furthermore, a number of parameters which are usually considered constant, should also be expressed as dependent on temperature and pressure.

Another way to avoid the intricacy of this interpretation is founded in a pure statistical approach when considering the so called micro-heterogenous systems[4, 5].

The bubble growth dynamics is usually treated by means of a mathematical model in which the bubble is assumed to be in the thermodynamic equilibrium with the liquid phase and, for the heat transfer and nucleation rate, instead of real some plausible values are used. Similarly, in the case of a two phase flow, the relative vapor phase velocity is usually considered constant. As a matter of fact, these values should be taken as functions of the corresponding velocity, temperature and density fields for liquid and vapor as well. Unfortunately, these function are generally unknown as of yet[6, 7, 8, 9, 10].

Only by better understanding of the mechanism of nucleation and bubble growth, one can expect to solve this problem. The first step in resolving it should enable one for the precise observation and accurate measurements.



The difficulties for doing this come from the extreme agility and growth velocity of the bubble; its small size; and the instability of the liquid phase in which the bubble usually appears.

In the proposed apparatus, which is designed in a way to force a single bubble to stay at a definite place, a direct observation of the bubble under the controlled conditions and the precise measurements of relevant parameters are made possible. Consequently, this will enable one to define and estimate the dependence of the nucleation and bubble growth upon these parameters.

A disk shaped, water filled vessel (1) rotates with a controlled angular velocity ω (Fig. 1). The minimum static pressure along the disk axis can be controlled independently by varying the pressure inside the pressurizer (2) which is connected with the disk by a thin tube (3) and a gasket. Presumably, it should be possible to establish either a constant temperature or the stationary convective velocity field inside the water disk by an appropriate use of outer heating (4) and gas blowing (5). Thus, not only the maximum pressure but also the maximum temperature may exist in the center of the disk.

The depression along the disk axis below the critical pressure will give rise to the bubble. For the purpose of some particular experiments the bubble can be excited by definite amount of radiation energy absorbed. For instance, the beam L of a laser can be directed under the angle α through the disk center. In such a way the maximum local absorption will be reached just at that point.

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