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Letter to the Editors

Comment on the paper by H. Wang, X.F. Peng, B.X. Wang, and D.J. Lee "Jet flow phenomena during nucleate boiling"
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The paper [1] presents important new experimental data on nongravity hydrodynamics of nucleate boiling.

As it is shown in [2,3] nucleate boiling on a thin wire is marked by conditions favorable for manifestation of nongravity mechanisms of heat and vapour removal.

In the work [1] such a unique conditions firstly are used for detailed experimental study of the basic features of nucleate boiling.

Using high-speed video system "Jet flows were fixed generated from the sites on the wire or top part of some bubbles, and formed track-like tails in the bulk liquid. Jet flow phenomena were complex and diverse, and occurred either before common nucleate boiling beginning or during the nucleate boiling process" [1].

By this means leading role is neatly reflected of a "pumping effect" of growing bubble (jet-like heat removal mechanism) established in [4,5] and supported only by episodic isolated direct and indirect experimental evidences [5–9]. From this point of view the results [1] are of fundamental importance in the field of boiling hydrodynamics and heat transfer.

At the same time the paper [1] lacks consideration of the presented results in the context of existing theoretical concepts and experimental data. An attempt to close this gap is made below.

According to [4,5] generation of a jet flow is resulted by drastic nonuniformity of evaporation on the surface of a bubble starting growth within the layer with the high temperature gradient. Following to [6] acceleration corresponding to pressure gradient resulted by variability of dynamic reaction of evaporation may exceed normal acceleration of gravity force more than by two orders of magnitude.

Nongravity character of the phenomenon observed most impressively manifests itself in "shooting" of bubbles by flow named by the authors as a bubble-bunch jet flow. Besides, such a shooting initially is oriented irrespective to gravity field.

As it is shown in [2,3] low heat capacity of thin wire and its insignificant hydraulic resistance to transverse jet flow creates possibility of fast transition of the bubble from the role of the generator of the jet to the role of the object to be swept away by the same jet continuing by inertia as it is observed in the bubble-bunch jet flow. Similar character of a bubble departure was observed also in experiments [7].

Another aspect of investigation is connected with evaluation of contribution of thermocapillarity in the generation of a jet flow [10]. As it follows from [6] in this process the role of the aforementioned pressure gradient is much greater than possible role of thermocapillarity if pure vapour–liquid system is considered.

In this regard it is important that in experiments [1] special measures were performed for full recession of dissolved gases excluding occurrence of any sensitive temperature gradient at a bubble surface.

Based at the presented experimental results in [1] qualitative conclusion is made about high intensity of the jet-like mechanism. Validity of this conclusion especially is supported by jets "generated from the sites" and "before common nucleate boiling" reflecting detectability of the pumping effect even at initial microscopic stage of the bubble growth. At the same time intensity of the jet-like mechanism needs further detailed quantitative investigation.

The work [1] as a whole may be considered as the first important step putting an end to long-term delay with deep and systematic study of the effect representing basic feature of boiling hydrodynamics. Hopefully, as a consequence of its substantial new impetus will be given to further development of boiling heat transfer theory based at models and approaches [2–6,11,12].

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