Development of oscillations of the gas-liquid meniscus in a capillary under the imposed temperature difference

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ABSTRACT

Let a gas bubble be confined between a sealed end of a capillary and a liquid plug. The other end of the capillary is open and is connected to a large reservoir filled partially by the liquid; its pressure p_r is thus constant. The liquid end is maintained at a temperature T_c and the liquid end, at a larger temperature T_e. The gas is the vapor corresponding to the liquid. When $\Delta T = T_e - T_c$ exceeds a threshold, the gas-liquid meniscus begins to oscillate. Such a system is a simplest version of an industrial device that serves to transfer the heat from the hot gas end to the cold liquid end. It is called the pulsating heat pipe (PHP) and is used for cooling of electronics, engines, etc. PHP is the most efficient of all kinds of heat pipes but its principle of action is not yet understood. Such oscillations serve to propel a toy boat ("pop-pop" or "putt-putt" boat). The instability that causes the oscillations was studied recently both experimentally and theoretically [1]. In this communication we describe a theoretical model of this system and present its linear stability analysis. We show also the experimental results obtained in a cryogenic experiment where N_2 at 75K is used as a fluid.

REFERENCES

[1] S. Das, V. Nikolayev, F. Lefevre, B. Pottier, S. Khandekar, J. Bonjour, *Thermally induced two-phase oscillating flow inside a capillary tube*, Int. J. Heat Mass Transfer **53**, 3905-3913, 2010.