Continuous vs. pulsating flow boiling. Part 1: Experimental comparison and visualization

This experimental study investigates an active method for flow boiling heat transfer enhancement by means of fluid flow pulsation. The hypothesis is that pulsations increase the flow boiling heat transfer by means of better bulk fluid mixing, increased wall wetting and flow-regime destabilization. The fluid pulsations are introduced by a flow modulating expansion device and are compared with continuous flow by a stepper-motor expansion valve in terms of time-averaged heat transfer coefficient. The cycle time ranges from 1 s to 9 s for the pulsations. The time-averaged heat transfer coefficients are reduced from transient measurements immediately downstream of the expansion valves at low vapor qualities. The results show that the pulsations improve the time-averaged heat transfer coefficient by 3.2 % on average at low cycle time (1 s to 2) s, whereas the pulsations may reduce the time-averaged heat transfer coefficient by as much as 8 % at high heat flux ($q \geq 35 \text{ kW/m}^2$) and cycle time (8 s). The latter reduction is adhered to the significant dry-out when the flow modulating expansion valve is closed.

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