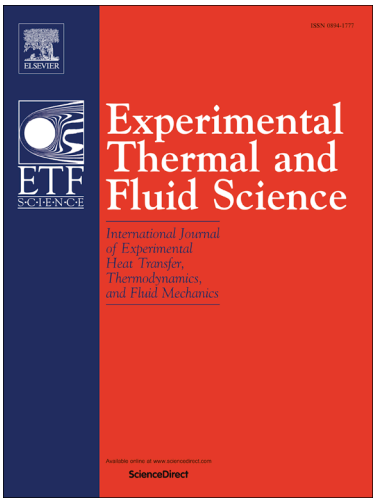

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Experimental Research on Pressure Drop Fluctuation of Two-phase Flow in Single Horizontal Mini-channels

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Abstract

The pressure drop fluctuation of two-phase flow in single horizontal mini-channels with diameters of 1.2 mm, 1.6 mm and 2.0 mm was experimentally investigated. Degassed water was tested in circular horizontal mini-channels with diameters of 1.2 mm, 1.6 mm and 2.0 mm at liquid mass fluxes of 21.2, 42.4 and 84.8 kg m^{-2} s^{-1} as well as heat fluxes of 0~216 kW m^{-2}. The pressure drop and the mini-channel wall temperature profiles as well as the visualisation results were recorded. Three basic types of the two-phase flow pressure drop fluctuation were identified based on the characteristic frequency, *i.e*. the low-frequency fluctuation (f<2.0 Hz), the medium-frequency fluctuation (2.0 Hz<f<10.0 Hz) and the high-frequency fluctuation (f>10.0 Hz). Besides, it was found that there existed three types of superimposed-frequency fluctuation. Pressure drop fluctuation maps were presented for three diameter channels, showing the single-phase region, the superimposed-frequency region and the low-frequency fluctuation region. The pressure drop fluctuation region depends on the ratio of the heat flux and the mass flux and the channel diameter. The periodic vapour catapult phenomenon was found during the low-frequency fluctuation, which was inferred to be caused by the bubbly/annular alternating flow pattern transition. It was found that the pressure drop and the wall temperature had the approximate fluctuation period with the periodic vapour catapult process. The medium-frequency fluctuation and the high-frequency fluctuation are related to the passage of the elongated bubbles with different periods. In superimposed medium and high frequency fluctuation, the amplitude of the pressure drop fluctuation is relatively low and no synchronous fluctuation was observed between wall temperature and pressure drop profiles.

Key Words

Mini-channel; Two-phase flow; Pressure drop fluctuation; Vapour catapult

Nomenclature

A	surface area (mm^2)	T_f	liquid temperature (°C)
C_p	Specific heat capacity (J kg^{-1} K^{-1})	T_w	wall temperature (°C)
d	diameter (mm)	u	velocity (m s^{-1})
f	friction factor (-)	U	electric voltage (V)
G	mass flux (kg m^{-2} s^{-1})	V	vapour phase
h	heat transfer coefficient (W m^{-2} K^{-1})		
h_{fg}	latent heat of evaporation (J kg^{-1})		
H	high-frequency fluctuation	*Subscripts*	