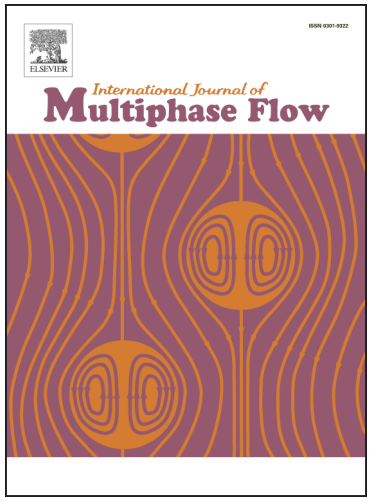

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PII: S0301-9322(14)00088-3
DOI: http://dx.doi.org/10.1016/j.ijmultiphaseflow.2014.04.009
Reference: IJMF 2044

To appear in: *International Journal of Multiphase Flow*

Received Date: 3 April 2014
Accepted Date: 29 April 2014

Please cite this article as: Borhani, N., Thome, J.R., Intermittent dewetting and dryout of annular flows, *International Journal of Multiphase Flow* (2014), doi: http://dx.doi.org/10.1016/j.ijmultiphaseflow.2014.04.009

Intermittent dewetting and dryout of annular flows

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Abstract

Flow visualisation of saturated flow boiling of refrigerant R245fa in a silicon parallel multi-microchannel evaporator, at low mass flux and moderate uniform heat flux, has been carried out with a high-speed digital camera. Using the time-strip technique to post-process the recorded image sequences has revealed profound details regarding the intermittent dryout mechanism of annular flows. Features of these observed phenomena have been successfully correlated with the dynamics expected from a ruptured metastable liquid film under shear. These observations can act as a basis for the development of new mechanistic critical heat flux prediction models and the design of future high heat flux devices. This study also reveals details concerning the nature of the droplet entrainment-deposition process and nucleate boiling in very thin annular liquid films.

Keywords: annular flow, film rupture, dryout, critical heat flux, high-speed flow visualisation.

1. Introduction

Details of many two-phase fluid dynamic mechanisms governing flow boiling phenomena occurring in micro-evaporators are currently lacking. As a result of this, current prediction methods, which are essential for the design of the next generation of high heat flux devices, are either based on empirical correlations derived from databases of experimental data or on mechanistic models based on over simplified physics.

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