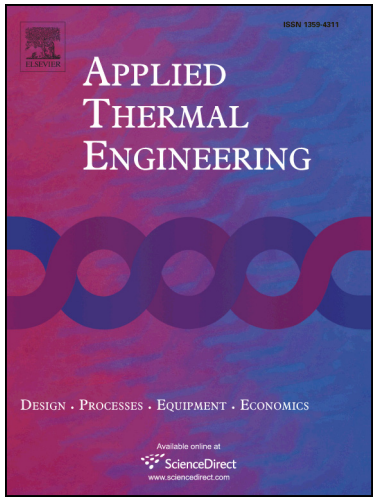

Research Paper

A Numerical study of the transition from slug to annular flow in micro-channel convective boiling

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A Numerical study of the transition from slug to annular flow in micro-channel convective boiling

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Abstract

A numerical study on the transition from slug flow (or elongated flow) to annular flow of convective boiling under high heat flux in a micro-channel with diameter of 0.4 mm is conducted. A constant velocity inlet boundary with mass flux 400kg/m^2 s, and heated wall with a constant heat flux (160, 80kW/m^2) are applied. A novel initialization method is proposed. Growth rate of the bubble and transition of the flow regime are well predicted by comparing with an experimental visualization. Effects of the transition are studied and findings are that this process disturbs thermal boundary layer which further enhances bubble evaporation.

Key words

Boiling, CFD, micro-channels, transition, heat transfer.

Nomenclature list

Latin letters		*Greek Letters*	
A	area	α	volume fraction
C	coefficient	β	constant
c	specific heat	δ	thickness
Ca	capillary number	θ	contact angle
D	diameter	μ	viscosity
F	force	λ	thermal conductivity
G	mass flux	ρ	density
h	enthalpy	σ	surface tension
$\boldsymbol{k}$	curvature	Φ	level set function
$\boldsymbol{n}$	normal vector	Ω	interface region
N	normalized factor		
L	Length	*Subscripts*	
Pr	Prandtl number	b	bubble
q	heat flux	c	coalescence
R_{int}	thermal resistance	e	evaporation
Rg	gas constant	g	gas
Re	Reynolds number	gr	grid
S	Source term	int	interface
T	temperature	l	liquid
t	time	p	constant pressure
$\boldsymbol{u}$	velocity vector	sat	saturation
X	coordinate	t	tube
Y	coordinate	v	vapor
		w	wall

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