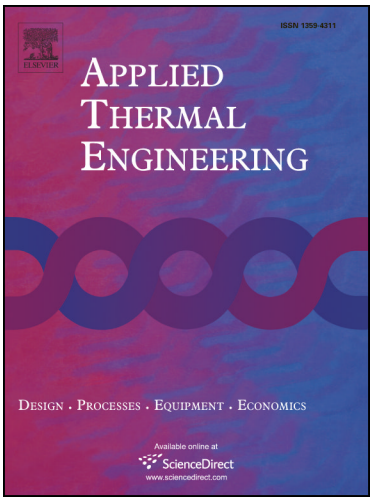

Research Paper

Enhancement of boiling heat transfer using hydrophilic-hydrophobic mixed surfaces: A lattice Boltzmann study

Q. Li, Y. Yu, P. Zhou, H.J. Yan

PII: S1359-4311(17)37140-5
DOI: https://doi.org/10.1016/j.applthermaleng.2017.12.105
Reference: ATE 11626

To appear in: *Applied Thermal Engineering*

Received Date: 7 November 2017
Revised Date: 26 December 2017
Accepted Date: 28 December 2017

Please cite this article as: Q. Li, Y. Yu, P. Zhou, H.J. Yan, Enhancement of boiling heat transfer using hydrophilic-hydrophobic mixed surfaces: A lattice Boltzmann study, *Applied Thermal Engineering* (2017), doi: https://doi.org/10.1016/j.applthermaleng.2017.12.105

Enhancement of boiling heat transfer using hydrophilic-hydrophobic mixed surfaces: A lattice Boltzmann study

Q. Li*, Y. Yu, P. Zhou, H. J. Yan

School of Energy Science and Engineering, Central South University, Changsha 410083, China

Abstract

In this paper, the boiling heat transfer performance on a type of hydrophilic-hydrophobic mixed surfaces and the underlying enhancement mechanism are numerically investigated using a thermal multiphase lattice Boltzmann model with liquid-vapor phase change. The mixed surface is textured with pillars consisting of hydrophilic side walls and hydrophobic tops, in which the combination of mixed wettability and microstructures is applied. It is found that the hydrophobicity of the tops of pillars promotes bubble nucleation and reduces the required wall superheat for the onset of nucleate boiling; however, it also makes the boiling process enter into the film boiling regime at a lower wall superheat. The interaction between the bubbles nucleated at the corners and the bubbles on the tops of pillars is observed during the boiling process on the mixed surface, which speeds up the departure of the bubbles nucleated at the corners. Moreover, comparisons of the heat flux and the heat transfer coefficient are made between textured surfaces with different wettability: homogeneous wettability, heterogeneous wettability, and hydrophilic-hydrophobic mixed wettability, which reveal that increasing the contact angle of the tops of pillars leads to a leftward shift of the boiling curve and a leftward and upward shift of the heat transfer coefficient curve. Furthermore, the effects of the pillar height and width are also studied.

Key words: Boiling; Hydrophilic-hydrophobic; Mixed wettability; Lattice Boltzmann model.

*Corresponding author: qingli@csu.edu.cn