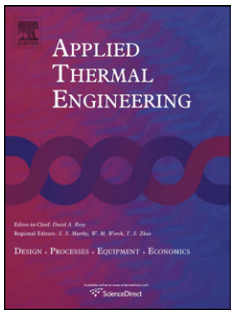
Accepted Manuscript



Study of heat transfer enhancement for structured surfaces in spray cooling

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PII: S1359-4311(13)00411-0

DOI: 10.1016/j.applthermaleng.2013.05.047

Reference: ATE 4848

To appear in: *Applied Thermal Engineering*

Received Date: 21 March 2013

Revised Date: 25 May 2013

Accepted Date: 29 May 2013

Please cite this article as: J.L. Xie, Y.B. Tan, F. Duan, K. Ranjith, T.N. Wong , K.C. Toh, K.F. Choo, P.K. Chan, Study of heat transfer enhancement for structured surfaces in spray cooling, *Applied Thermal Engineering* (2013), doi: 10.1016/j.applthermaleng.2013.05.047.

Study of heat transfer enhancement for structured surfaces in spray cooling

J.L.Xie, Y.B. Tan, F. Duan, K. Ranjith, T.N. Wong [a,*]
K.C. Toh, K.F. Choo[b], P.K. Chan[c]
[a] *School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore*
[b] *Temasek Laboratories @ NTU, Singapore*
[c] *DSO National Laboratories, Singapore*

Abstract

Experiments were conducted to study the heat transfer effects of enhanced surfaces in spray cooling. The enhanced surfaces including micro-, macro- and multiscale-structured shapes along with a referenced smooth flat surface were tested in a closed loop system with R134a as the working fluid. The experimental results indicate that fin arrangement rather than a simple increase in wetted area plays a decisive role in the cooling performance of macro-structured surfaces. The micro-structured flat surface was suggested to enhance nucleate boiling by providing more potential nucleation sites and capillary effects. Despite having the same surface geometries, multiscale-structured surfaces with planted micro-structures outperformed macro-structured surfaces in terms of heat transfer enhancement. Using the smooth flat surface as a baseline, the micro-structured flat surface produced a relative heat transfer enhancement of 32% compared to the 36% of the macro-structured surfaces, while the multiscale-structured surfaces achieved a heat transfer enhancement of up to 65%. In addition to improving heat transfer performance, macro-structured surfaces provide other advantages such as prolonging the transition process and reducing the period of time which the heater surface remains in the extremely high temperature regime (film boiling) after power is switched off.

Keywords: Enhanced heat transfer, Structured surfaces, Spray cooling

* Corresponding author. Tel.: +65 67905587; fax: +65 67954623

E-mail address: mtnwong@ntu.edu.sg (T. N. Wong)