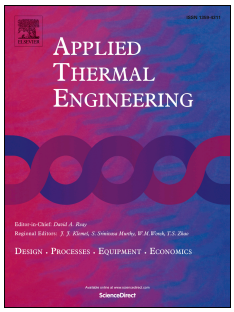
Accepted Manuscript



Experimental Investigation of the Thermal Management of Flat-Plate Closed-Loop Pulsating Heat Pipes with Interconnecting Channels

M. Ebrahimi, M.B. Shafii, M.A. Bijarchi

PII: S1359-4311(15)00724-3

DOI: 10.1016/j.applthermaleng.2015.07.040

Reference: ATE 6839

To appear in: *Applied Thermal Engineering*

Received Date: 10 May 2015

Revised Date: 15 July 2015

Accepted Date: 17 July 2015

Please cite this article as: M. Ebrahimi, M.B. Shafii, M.A. Bijarchi, Experimental Investigation of the Thermal Management of Flat-Plate Closed-Loop Pulsating Heat Pipes with Interconnecting Channels, *Applied Thermal Engineering* (2015), doi: 10.1016/j.applthermaleng.2015.07.040.

Experimental Investigation of the Thermal Management of Flat-Plate Closed-Loop Pulsating Heat Pipes with Interconnecting Channels

M. Ebrahimi [a,b], M.B. Shafii [a,*], M.A. Bijarchi[a]

[a] *Department of Mechanical Engineering, Sharif University of Technology, P.O. Box 11365-9567, Tehran, Iran*
[b] *Sharif Energy Research Inst. (SERI), P.O. Box 1459-777611, Tehran, Iran*
* Corresponding author. Tel.: +98 21 6616 5558; fax: +98 21 6600 0021.
E-mail address: behshad@sharif.edu (M.B. Shafii).

Abstract

A desired circulatory flow in flat-plate closed-loop pulsating heat pipes (FP-CLPHPs), which may ameliorate electronic thermal management, was achieved by using the new idea of interconnecting channels (ICs) to decrease flow resistance in one direction and increase the total heat transfer of fluid. In order to experimentally investigate the effects of the IC, two aluminum flat-plate thermal spreaders—one with ICs (IC-FP-CLPHP) and one without them—were fabricated. The FP-CLPHPs were charged with ethanol as working fluid with filling ratios of 35%, 50%, 65%, and 80% by volume. Performance of interconnecting channels in different heat inputs was explored, and the results demonstrated the higher performance of pulsating heat pipes with ICs in comparison with heat pipes without them in a wide range of heat inputs and filling ratios. It has been observed that the most efficient performance of IC-FP-CLPHP occurred at the filling ratio of 65%. Flow visualization indicated that interconnecting channels affect the flow regime and enhance flow circulation and heat transfer in CLPHPs. In furtherance of investigating the viability of the idea, numerical procedure has been followed on a single-phase liquid to show the role of interconnecting channels in achieving one-way flow.

Keywords: Flat-plate pulsating heat-pipe; Interconnecting channels; Circulatory flow; Unidirectional flow; Thermal management.

1. Introduction

Thermal management is a significant issue in industrial applications. Phase change heat transfer is an efficient solution for heat removal in many implementations such as electronic equipment [1-3], solar collectors [4], energy applications [5, 6], and reducing the relative humidity in drying systems [7, 8].

Pulsating heat-pipes (PHPs), first introduced by Akachi [9], is a state-of-the-art system to solve thermal management problem and is now increasingly pervasive. PHP is a long capillary tube which is bent into a meandering shape. It does not include an additional capillary structure (wick). Accordingly, it is not subjected to some restrictions associated with the conventional heat pipes [10]. There are two types of PHPs:

- Closed-loop PHPs without check valves or with check valves
- Open-loop PHPs