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Design of a Two-Phase Loop Thermosyphon for Telecommunications System(I)
— Experiments and Visualization —

S.H. Rhi*, Won Tae Kim, Kyu Sub Song*** and Yung Lee***

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A two-phase loop thermosyphon system is developed for the B-ISDN telecommunications system and its performance is evaluated both experimentally and by visualization techniques. The design of the thermosyphon system proposed is aimed to cool multichip modules (MCM) upto heat flux of 8 W/cm^2. The results indicate that in the loop thermosyphon system, cooling heat flux is capable of 12 W/cm^2 with two condensers under the forced convection cooling of the condenser section with acetone or FC-87 as the working fluid. The instability of the working fluid flow within the loop is observed using the visualization techniques and temperature fluctuation is stabilized with orifice insertion.

Key Words: Two-Phase Loop Thermosyphon, B-ISDN Telecommunications, Visualization, Flow Instability, Orifice Inserts

Nomenclature

h_{fg}	: Latent heat of vaporization (J/kg)
L^+	: l_c/l_e
m	: Mass flow rate (kg/s)
q	: Heat flux (W/cm^2)
t	: Time (s)
T_h	: Temperature at the center of evaporator within heater (℃)
TCT	: Two-phase closed thermosyphon
TLT	: Two-phase loop-type thermosyphon
Δt_{h-air}	: Overall temperature difference (℃)
U	: Overall heat transfer coefficient (W/m^2 K)
V	: Volume (m^3)
V^*	: Non-dimenasionlized volume as defined in Eq. (4)

Subscripts

c	: Condenser section
e	: Heated zone
ev	: Evaporator section
f	: Fluid
h	: Hot
T	: Total
WF	: Working fluid

Greek letters

ρ	: Density (kg/m^3)

* Department of Mechanical Engineering, University of Ottawa, Ottawa, Ontario, Canada
** Department of Industrial Engineering, Kongju National University, Chungnam, KOREA
*** Packaging Technology Section, Electronics and Telecommunications Research Institute(ETRI), Taejon, KOREA

1. Introduction

It has been known for a long time that very effective heat transfer could be obtained by means of evaporation and condensation of a fluid. For past two decades heat pipes have been typically used in space applications, where the needs for spacecraft temperature equalization and for transferring heat to radiate surfaces without power-driven pumps. The use of heat pipes is currently expanding into areas with increasing density and higher heat dissipation in electronics, where high heat dissipation causes extreme temperature gradi-