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Experimental study of an ammonia loop heat pipe with a flat disk-shaped evaporator using a bimetal wall

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Abstract

A loop heat pipe (LHP) with a flat disk-shaped evaporator 40 mm in diameter and 18 mm in thickness has been developed and tested. The device was made of stainless steel and equipped with a main nickel biporous wick and a secondary wick made of a porous material with a low thermal conductivity. The flat evaporator wall being heated was made of a “stainless steel – copper” bimetal. The working fluid was ammonia. The LHP thermal characteristics were investigated at different orientations with slopes from -90° to $+90^\circ$ and heat sink temperatures in the range from 0 to 40 °C. A maximum heat load of 300 W (23.9 W/cm²) at an evaporator temperature of no more than 80 °C was achieved at both a favorable and a horizontal orientation of the LHP. A minimum thermal resistance of the evaporator of 0.067 °C/W was obtained at a heat load of 220 W. The corresponding value of the LHP thermal resistance was equal to 0.084 °C/W. It has been found that under changes of orientation in the whole range of slopes the maximum heat load changes no more than 30 %. It is shown that a heat source temperature not more than 85°C can be ensured in all test conditions at heat loads up to 140 W.

Keywords

Loop heat pipe, flat evaporator, wick, thermal resistance, heat flux, heat load, electronics cooling.

Nomenclature

G – flow rate, l/min

ID - inner diameter, m

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