Experimental investigation of flat plate cryogenic oscillating heat pipe

Vivek Patel, Nirvesh Mehta, Kamlesh Mehta, Amarish Badgujar, Shreya Mehta & Nisha Bora

Abstract

Recent developments in applications such as high-temperature superconducting magnets, infrared detectors, and electronics components have led to an alarming increase in heat dissipation rate, which now far exceeds the capability of conventional heat pipe cooling systems. This trend is responsible for a recent transition to flat plate oscillating heat pipes. A new flat plate cryogenic oscillating heat pipe (FPC-OHP) has been developed and validated through experimentations. The performance evaluation of FPC-OHP was investigated with temperature measurements. FPC-OHP consisted of evaporator, condenser, and adiabatic section with the dimensions of $93 \times 70 \times 8$ mm^3. The FPC-OHP was made of copper alloy and fabricated by a vertical milling machine, having square channels with a hydraulic radius of 0.66 mm. Liquid nitrogen was used as a working fluid with a charge ratio of 60%. Experimental results revealed the maximum heat transport capability up to 300 W. Moreover, the thermal resistance decreased from 0.25 to 0.11 K/W corresponding to an increase in the heat load from 25 to 300 W. The average temperature difference between evaporator section and condenser section reached up to 34 K for 300 W. The measured effective thermal conductivities were found to be 7353 W/m K.