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COPPER-WATER LOOP HEAT PIPES: ISSUES AND ACHIEVEMENTS

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ABSTRACT

Copper-water loop heat pipes (LHPs) are promising devices for providing an effective thermal link between a heat source and a heat sink in cooling systems of powerful objects having relatively small dimensions and operating in the temperature range from 50 to 100 °C. Thermophysical properties of water as a working fluid and high thermal conductivity of copper as a constructional material for a body and a wick as well as their good compatibility make it possible to achieve an extremely high heat flux and low thermal resistance of such LHPs. Today the obtained values of these parameters are close to 900 W/cm^2 and 0.04 °C/W, respectively. However, making copper-water LHPs one has to overcome a serious contradiction between the high thermal conductivity of copper and the low value of $\frac{dP}{dT}$ which water has at a temperature below 100 °C.

Computer simulations and experimental investigations of copper-water LHPs have shown that despite the mentioned contradiction achievement of high performance characteristics is possible with optimal choice of design parameters of devices.

The paper presents results of development, experimental and numerical investigations of LHPs made entirely of copper and supplied with a cylindrical and a flat evaporator with water as a working fluid. Examples of the use of the given devices in cooling systems of different electronics are shown here.