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Optimum Transport in Flat Heat Pipes YU-WEI LIU, MARIN SIGURDSON, PAYAM BOZORGI, NOEL MACDONALD, CARL MEINHART, UCSB
— In this study we investigate wetting behavior of the wick structure and the maximum theoretical heat transfer rate of a 40 cm titanium flat heat pipe. Large scale flat heat pipes are designed for high performance electronics cooling. Wick designs in flat heat pipes are typically limited by viscous drag and capillary pressure, and do not transport fluids as sufficient rates to meet practical cooling requirements. An analytical model is used to describe flow through wick structure with array of pillars. The capillary pressure and viscous drag are obtained by surface energy calculation and numerical simulations, respectively. To verify the model, we conducted wetting tests on the wick samples with different pillar dimensions. The model agrees qualitatively with the experiments, but under predicts the viscous drag. We extend the model to calculate the pressure drop for liquid and vapor flows, which predicts the upper limit for heat transport in flat heat pipes. Pillar parameters are optimized for maximum heat transfer rate, which approaches several hundred of Watts.

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