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Capillary-Driven Flow through Optimal Wick Structures for Heat Pipe Applications YU-WEI LIU, MARIN SIGURDSON, CARL MEINHART, UCSB — In this study we investigate surface tension-driven fluid motion through the wick structure of a flat heat pipe. Wick designs in flat heat pipes are typically limited by viscous drag and capillary pressure, and do not transport fluids at sufficient rates to meet high-demand cooling requirements. An analytical model is used to describe flow through wick structure with array of channels. The capillary pressure and viscous drag are obtained by calculating surface energy difference and solving Stokes equations, respectively. To verify the model, we conducted wetting tests on the wick samples with different channel dimensions. The model agrees qualitatively with the experiments, but under predicts the viscous drag, which is due to the meniscus effect at the surface. The concave liquid surface increases the pressure drop, and therefore reduces the effective permeability. To include the meniscus effect, we combined Stokes equations with deformed surface in a full 3D simulation by COMSOL V4.2a (COMSOL, Inc., Stockholm, Se). The Young-Laplace law and the curvature equation are used to determine the deformed surface.

Yu-Wei Liu
UCSB

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