Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Capillary Flow Limitations of Nanowicks CONAN ZHANG, CARLOS HIDROVO, University of Texas-Austin — Thermal management is an important issue in microelectronic systems. The inaccessibility and diminishing size of these systems, however, requires that the heat management components be reliable and compact, such as is the case with heat pipes. In most intermediate temperature heat pipes typically found in microelectronics, the critical heat flux is governed by the capillary limit. Given the projected increases in computer chip heat fluxes, it is important to investigate the use of nanowicks as a means of raising this capillary limit. A theoretical model was developed to simulate flow through a vertical nanopillar array by balancing the capillary driving forces and the viscous losses in a quasi-steady state dynamic formulation. Based on this model, the maximum mass flow and its critical heat flux can be found for a wick given its microstructure geometry. These values were also found experimentally for commercially available wicks and nanowicks. We found that nanowicks provide lower mass flow rates than conventional wicks, mainly due to a reduced cross section. However, nanowicks achieved higher velocities and show promise over some conventional heat pipe wicks.

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Date submitted: 05 Aug 2009 Electronic form version 1.4