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Boiling Phenomena of Capillary Flow in Heat Pipe Applications

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The University of Texas at Austin — Boiling is scarcely documented in heat pipe literature due to the complexity of the phenomena. Most heat pipe designers simply avoid the boiling limit and design systems that operate well below boiling. However, with recent technological advances and limited development of heat pipe technology, heat pipes are encountering higher temperatures. Consequently, it is important to understand the boiling phenomena associated with higher temperatures. This work presents experimental data at various heat fluxes and surface temperatures for micropillar wicks with different dimensions. The empirical data is evaluated against earlier theoretical work that predicts the onset of the capillary and boiling limits and their corresponding liquid flow rates for a given heat flux. Any disruption in capillary action caused by boiling can be identified by correlating the flow rate of the fluid through the porous structure with the surface temperature. When boiling occurs, the flow rate can be observed to deviate from expected values and the temperature increases substantially. Visual diagnostics via time lapse photography was also utilized to help visualize the fluid film at the different heat flux ranges.

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