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Liquid-Vapor Interface Configuration for Capillary Flow in a Heat Pipe[1] MUHAMMAD RIZWANUR RAHMAN, PRASHANT WAGHMARE, MORRIS R. FLYNN, University of Alberta — The shape of the liquid-vapor interface within a heat pipe wick is responsive to the wetting characteristics of the working fluid, wick geometry and other operational variables. This study critically investigates the underlying physics that dictate the interface shape and the manner in which this shape changes owing to a change of operating conditions. Far from being of academic interest, these details are essential to the effective functioning of the heat pipe, the interface shape dictating the degree of capillary pumping that occurs. In formulating our mathematical model, we exploit ideas otherwise applied to plastron respiration by aquatic insects. We thereby reject the popular simplification that the three-phase contact point is somehow anchored at a fixed elevation within the wick. Although multiple solutions are predicted, corresponding to different interface shapes, only one is mechanically stable and therefore physically-acceptable. When coupled with a complementary thermodynamic model, the unique interface shape can be predicted for prescribed operating conditions. Such information offers insights on the recess depth for entrainment minimization as well as fill ratio and optimized geometric dimensions for maximizing axial heat flow.

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