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Condensing Flows in High Aspect Ratio Channel Geometries[1]
CATHERINE KOVEAL, MATTHEW MCCARTHY, EVELYN N. WANG, Massachusetts Institute of Technology — We investigate condensing flow regimes in high aspect ratio rectangular geometries, where the width to height ratio ranges from 20-to-1 to 65-to-1. These geometries are designed for condenser layers of a novel capillary-pumped loop heat pipe design in a high performance heat sink. In this work, we study the effect of geometry, vapor mass flow rate, and surface design on condensing flow regimes and heat removal capability. We fabricated an experimental test rig which allows for optical access from the top, temperature measurements on the condensing surface, and controlled cooling from the bottom. In addition, the rig was placed on a tilt stage to examine the effect of a gravitational head on condensation. The experimental results show that the flow regimes are largely dictated by the dominant force, i.e., gravity, surface tension, or inertia. In addition, as the backside cooling temperature increased, the condensing length increased. Current work is focused on incorporating surface features to enhance heat transfer coefficients and to eliminate unstable condensation regimes.

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