

Public Abstract

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Title:FLOODED TWO-PHASE FLOW DYNAMICS AND HEAT TRANSFER WITH ENGINEERED WETTABILITY ON MICROSTRUCTURED SURFACES

Due to excessive droplet feeding, a period of flooding occurs as part of a typical droplet based thermal management cycle. The conventional superhydrophilic surface, which is designed for thin film evaporation because of its highly wettable character, has a limited improvement on the thermal performance during the flooded condition. This paper investigates micro-structures which combine micro-pillars and four engineered wettability patterns to improve the heat dissipation rate during flooding. Using the transient, 3-D volume-of-fluid (VOF) model, the bubble behaviors of growth, coalescence, and departure are analyzed within different micro-structures and the effects of pillar height and wettability patterns on the thermal performance are discussed. The wettability gradient patched on the pillar's side is demonstrated to promote the bubble's upward movement due to the contact angle difference between the upper and lower interfaces. However, insufficient pulling force results in large bubbles being pinned at the pillar tops, which forms a vapor blanket, and consequently decreases the heat transfer coefficient. When only a patch of hydrophobic material is present on the pillar top, effective pulling forces can be developed to help bubbles in the lower level depart from the pillar forest, since bubble merging between them generates most of the power required to pull the bubbles to the surface. The simulation results, including heat source temperatures and heat transfer coefficients, indicate that a patch of hydrophobic material on the pillar top works best out of all of the cases studied.