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Convection and evaporation rate of planar liquid films subjected to impulsive superheating[1] J.T. KIMBALL, J.C. HERMANSON, University of Washington, J.S. ALLEN, Michigan Technological University — The interfacial stability, convective structure, and evaporation rate of upward-facing, thin liquid films were studied experimentally. Four different working fluids were used. Films initially 5 mm to 100 μm thick were subjected to impulsive superheating. The films resided on a temperature controlled, gold-plated copper surface in a closed, initially degassed test chamber. Superheating was achieved by suddenly dropping the pressure of the saturated pure vapor in the test chamber. The dynamic film thickness was measured at multiple points using ultrasound, and instability wavelength and convective structure information was obtained by schlieren imaging. Considering previous quasi-steady results, the observed convection patterns in many cases suggest an initial, limited penetration of the convection structures into the film. The initial convection patterns and measured evaporation rate in these films are independent of the thermal boundary condition of the substrate. After a sufficiently long time, the convection pattern changes and approaches the previously observed quasi-steady condition.

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