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Stability of a Volatile Liquid Film Flowing Over a Locally-Heated Surface NAVEEN TIWARI, JEFFREY DAVIS, University of Massachusetts Amherst — The dynamics and linear stability of a volatile liquid film flowing over a locally-heated surface are studied using a long- wave analysis. The Marangoni stress at the heater induces a pronounced capillary ridge. A linear stability analysis of this ridge with respect to spanwise perturbations reveals that the operator of the linearized system can have both a discrete and continuous spectrum. The discrete spectrum appears above a critical value of the Marangoni number for a finite band of wavenumbers separated from zero. Above a second, larger critical value of the Marangoni number, a band of the discrete spectrum becomes unstable, corresponding to rivulet formation. For sufficiently large evaporation, a second band of unstable discrete modes appears, which is associated with an oscillatory, thermocapillary instability above the heater. The critical Marangoni number at instability has a non- monotonic dependence on the steepness of the temperature profile, and an energy analysis is used to gain insight into the instability mechanisms. Transient, non-modal amplification of over two orders of magnitude is found for films susceptible to both rivulet and thermocapillary instabilities for a narrow band of transverse wavenumbers different from those corresponding to the largest eigenvalues.

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