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Columnar Transitions in Microscale Evaporating Liquid Jets[1]
HANIF HUNTER, ARI GLEZER, Georgia Institute of Technology — Microscale evaporating liquid jets that are injected into a quiescent gaseous medium having adjustable ambient pressure are investigated over a range of jet speeds using a shadowgraph technique. The jets are formed by a laser-drilled 10 μm nozzle from a small-scale pressurized reservoir, and sub-atmospheric ambient pressure is maintained using a controllable, metered Venturi pump. The near-field jet features are captured by shadowgraph imaging using a pulsed ND-Yag laser and a 12 bit CCD camera where the field of view measured 200 μm on the side. As the ambient pressure is reduced, the jet column undergoes a series of spectacular transitions that are first marked by the appearance of vapor bubbles within the jet column. The transitions progress from columnar instabilities to series of column bifurcations to high-order branching and film formation and culminate in conical atomization of the jet column. In addition to the effects of the ambient pressure, the present investigation also considers effects of the liquid surface tension and vapor pressure on the onset, evolution, and hysteresis of the columnar transitions.

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