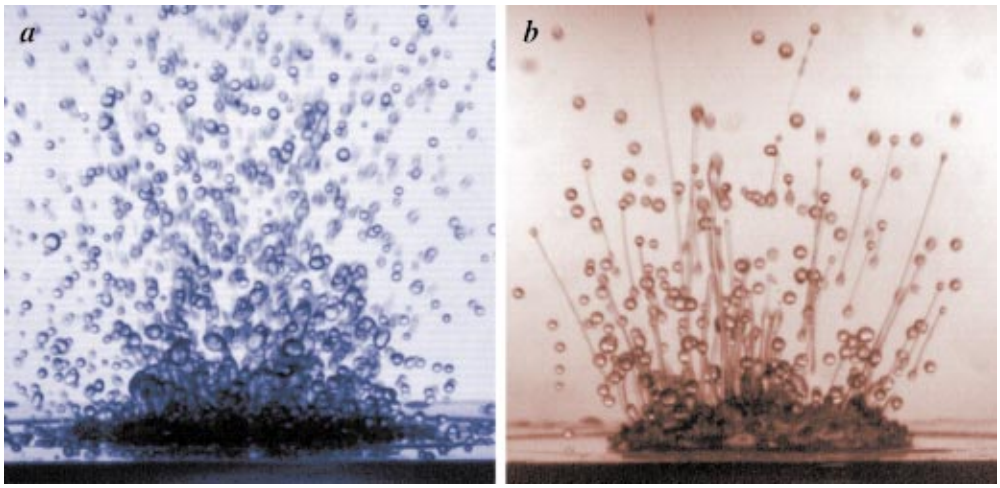

FIG. 1. Liquid spray formation during the atomization of a 0.1 ml drop at 1030 Hz: (a) water (μ=1 cP), and (b) glycerin/water solution (μ=79.7 cP).

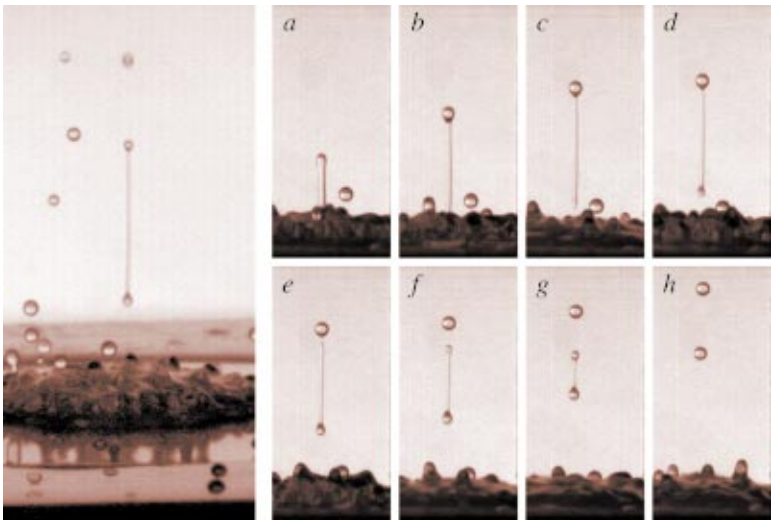

FIG. 2. Close-up images of the breakup of a spike that emanates from the drop in Fig. 1(b), t/T=1.5 (a), 3.5 (b), 5.1 (c), 5.6 (d), 6.6 (e), 7.1 (f), 8.2 (g), and 10.2 (h) (T is the forcing period).

Droplet Formation during the Atomization of a Viscous Liquid

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A sessile drop is atomized into a spray by an underlying oscillating diaphragm. The spray droplets are ejected and propelled away from the atomized drop following the breakup of liquid spikes that are initiated during the collapse of craters that form on the drop free surface.[1] The breakup mechanisms of the spike and the characteristics of the ensuing spray are strongly influenced by the liquid viscosity. For low-viscosity liquids, the spray droplets are formed by capillary necking and pinching near the tip of a short spike [Fig. 1(a)]. For higher viscosity liquids, the first breakup occurs near the stem of the spike, with or without a subsequent breakup of the detached, elongated liquid thread [Fig. 1(b)].

A typical breakup of the liquid thread in the high-viscosity ejection regime is shown in a sequence of high-speed images in Fig. 2. The atomized drop (glycerin water solution μ=79.7 cP) is forced at 1030 Hz and the diaphragm acceleration is set to be slightly above the onset of ejection. As the spike elongates [Figs. 2(a) and 2(b)], the primary breakup occurs at its stem [Fig. 2(c)], and a long liquid thread with an initial upward momentum is formed [Fig. 2(d)]. Subsequently, the thread undergoes a secondary breakup at its tip, and a main droplet is ejected [Fig. 2(e)]. The remaining liquid thread [Fig. 2(f)] recoils into the single satellite droplet [Figs. 2(g) and 2(h)]. If the initial aspect ratio of the thread is high enough, it may breakup into multiple secondary satellite droplets.

[1]B. Vukasinovic, A. Glezer, and M. K. Smith, ''Vibration-induced droplet atomization,'' Phys. Fluids **12**, S12 (2000).