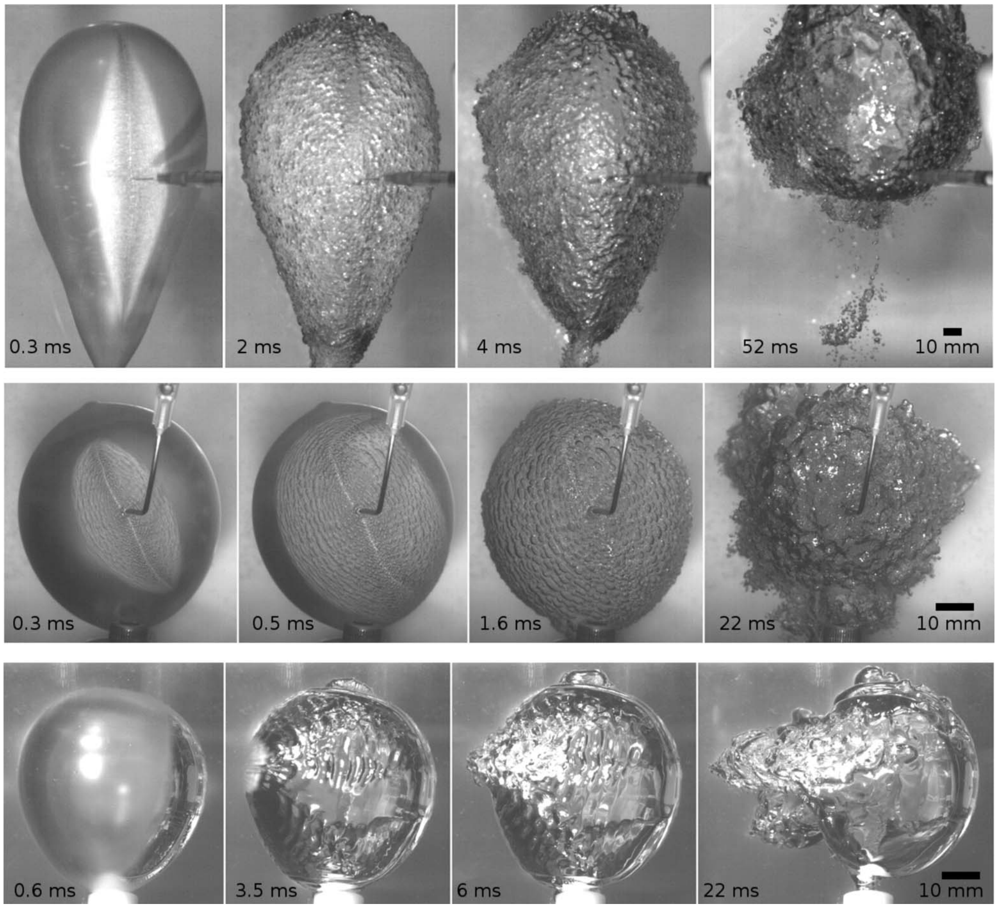

FIG. 1. An air balloon bursting in three different liquids (top to bottom): water (840 ml), acetone (180 ml), and corn oil (180 ml). The surface texture depends on the viscosity, surface tension and the capillary number, which for each liquid are: 1 mPa s, 72 mN/m, Ca=0.5 (water); 0.3 mPa s, 25 mN/m, Ca=0.4 (acetone); 89 mPa s, 20 mN/m, Ca=22 (oil). The times shown are after the puncture (enhanced online).[URL: http://dx.doi.org/10.1063/1.3207864.1]

Bubble surface texture and pulsation due to balloon bursting in different liquids

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We study the large bubble released in an initially quiescent dense liquid after the bursting of a submerged balloon filled with air. Such a large (volumes up to a liter) and almost stationary bubble is a condition unachievable by the usual methods of air injection. A number of instabilities are observed, some of which are typical of the deformation of an interface between two fluids of different densities, similar to the Rayleigh–Taylor instability.[1]

In Fig. 1, a time sequence of high-speed images is shown for an air bubble in three different liquids; the sharp object (needle) visible in two of the sequences is often needed to provide an initial puncture. Because the balloon itself is highly stretched by the inflation process, the motion of its skin while bursting is approximately tangential to the revealed bubble surface. This motion generates striated wrinkles, and the texture apparently becomes smoother with increasing viscosity (see the series in oil, Fig. 1).

Small bubbles are also produced at the surface, and two small jets are often seen. One corresponds to the original puncture point, and the other is due to the eventual departure of the rapidly retracting balloon skin, as is clearly visible in the last image of the series in oil (Fig. 1).

Furthermore, because the pressure inside the balloon is higher than the external pressure, the release of this pressure by the burst causes the bubble to pulsate several times[2] (evident in the video). Such oscillations are greater for higher internal pressures, which correspond to tauter balloons. These well-known oscillations have been observed under other conditions, for example, in the sudden boiling of drops.[3]

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