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Emerging string of fluid pearls

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How does a humidifier work? An ultrasonic humidifier makes our room humid by emitting mist through a cavitation process generated by a submerged piezoelectric transducer. When the humidifier is turned on, a rising fluid column appears and forms a string of fluid pearls as shown in Fig. 1(a).

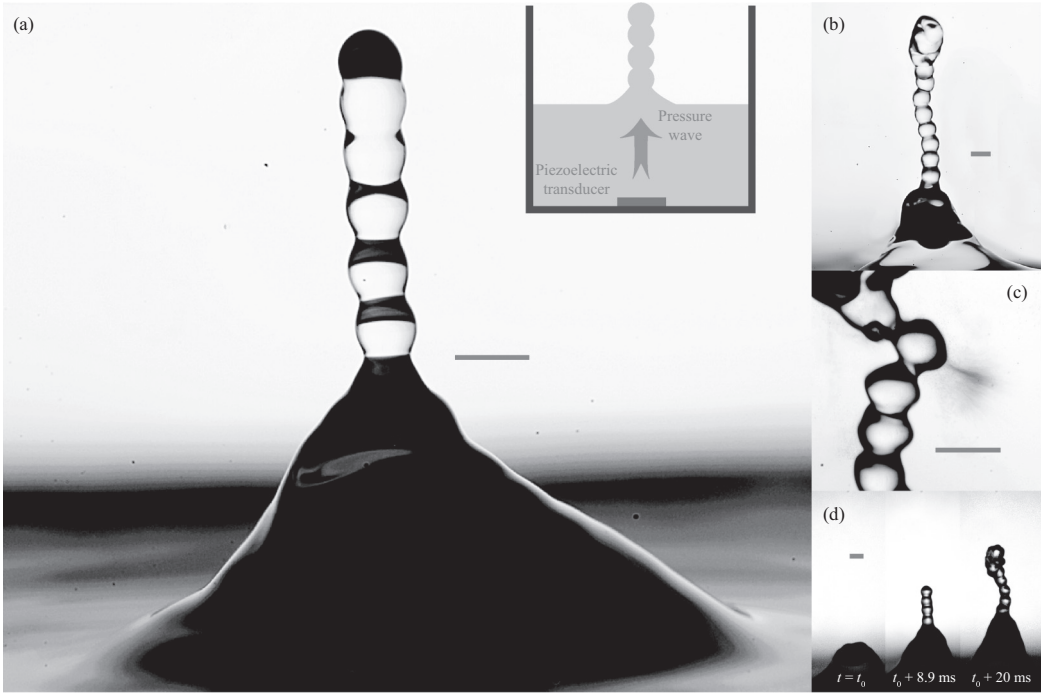

FIG. 1. (a) Emerging string of water pearls generated by a piezoelectric transducer submerged on the bottom of a water container as schematically shown in the inset. (b) Water becomes accumulated on the top as it reaches the maximum height. (c) Mist cloud being emitted into the air from the string of water pearls. (d) Sequential images of a developing fountain of water pearls. All the scale bars indicate 1 mm. DOI: http://dx.doi.org/10.1103/APS.DFD.2015.GFM.P0048

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A similar phenomenon was first reported by Rozenberg [1]. Clear visualizations of the fluid-pearl shape are captured in high resolution by the digital single-lens reflex camera (D810, Nikon Corp.) as shown in Figs. 1(a)–1(c). The periodic fluid fountain in a drop-chain shape with a wavelength of $\sim$1 mm is formed due to the pressure wave, which is generated by an ultrasonic vibration of 2.8 MHz of the piezoelectric transducer. The experimental setup is schematically shown in the inset of Fig. 1(a). As the fluid decelerates due to gravity, it accumulates at the apex of the fluid column as in Fig. 1(b). While continuing to form a fluid fountain, the cavitation process emits clouds of very fine droplets as in Fig. 1(c), which makes air humid. The time evolution of the same experiment is also recorded using the high-speed camera (Fastcam Mini 800K-M, Photron Inc.) at 10 000 frames/s. Figure 1(d) shows the sequential images from the moment that a fluid hill first forms at $t = t_0$ and then as a fountain of water pearls develops and further accumulates on the top.

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[1] L. Rozenberg, *Physical Principles of Ultrasonic Technology* (Plenum, New York, 1973).