Essential Toolkit for Dancing Droplets

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This study explores several ways to make liquid droplets levitate and oscillate. These physical phenomena are detailed through five different processes: the Leidenfrost effect, vibrations forced by a vibrating substrate, pulsed air flow, constant air flow and ultrasonic acoustic levitation. To date, the literature usually focuses on only one of these effects, and some of the key experimental aspects are sometimes unclear. We propose exploring all of these possibilities, providing a unique toolkit to study the levitation of liquid droplets and their star-shaped oscillations. All of the experimental procedures are well detailed, and we have improved some of them by using substrates treated with superhydrophobic nanoparticles. Using a high-speed camera and image processing methods, the radius of the droplet and the frequency of the oscillation are extracted. Our results are highly consistent with the models found in the literature. Thanks to an ultraviolet light, reliable vibration measurements are achieved in three dimensions, which are not currently explored in the literature. This contribution serves both basic and applied physics. It furthers basic science by offering the possibility of extracting the three-dimensional characteristics of droplets, thereby providing a better understanding of the hydrodynamic and non-thermal nature of the oscillations of Leidenfrost droplets. Examples of practical applications include the transportation of infinitesimal quantities of liquid without coming into direct contact with a solid substrate (in chemistry, process engineering, etc.), or the measurement of the physics constants of harmful or high-temperature liquids.

Awards Won:
Third Award of $1,000