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FLUID DYNAMICS

Exploding and flying Leidenfrost droplets

Put a droplet on a hot enough surface and it levitates, carried by a layer of its own vapour, a phenomenon known as the Leidenfrost effect. The properties of the vapour layer are well-characterized and exploited for applications such as drag reduction. However, the ultimate fate of the droplet as it continues to evaporate is little explored. Now, writing in *Science Advances*, Chao Sun and co-workers report that droplets either fly away or explode, depending on their initial size and purity.

The team found that in general, droplets that start with a radius between 1.1 mm and 2.5 mm explode (pictured) and smaller droplets fly away from the heated substrate. For pure liquids, with contaminant volume fractions of parts-per-million, the droplet can shrink to a radius of around 50 μm before exploding; adding contaminants to the liquid increases this explosion radius. The ratio of explosion radius to initial radius scales as the cube root of the contaminant volume fraction, for volume fractions ranging from 10^{-6} to 10^{-3}.

High-speed imaging of the droplets revealed that explosions are triggered when droplets come into contact with the heated surface. This contact occurs because contaminants slow down the evaporation of the droplet, thinning the vapour layer until it is comparable to the roughness of the lower surface of the droplet. However, a droplet that starts small shrinks until it reaches a point at which the upward force from the vapour layer is larger than the droplet weight, so it takes off.

This new understanding of droplet fates could open applications of the Leidenfrost effect such as controlled transport and deposition of particles.

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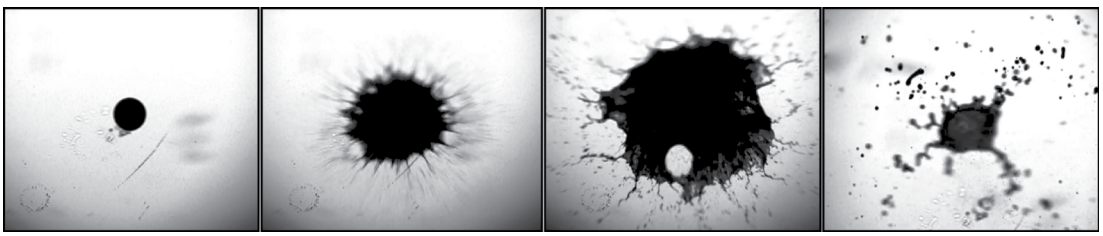
ORIGINAL ARTICLE Lyu, S. et al. Final fate of a Leindenfrost droplet: Explosion or takeoff *Sci. Adv.* **5**, eaav8081 (2019)



Credit: Chao Sun and co-workers, Tsinghua University, China