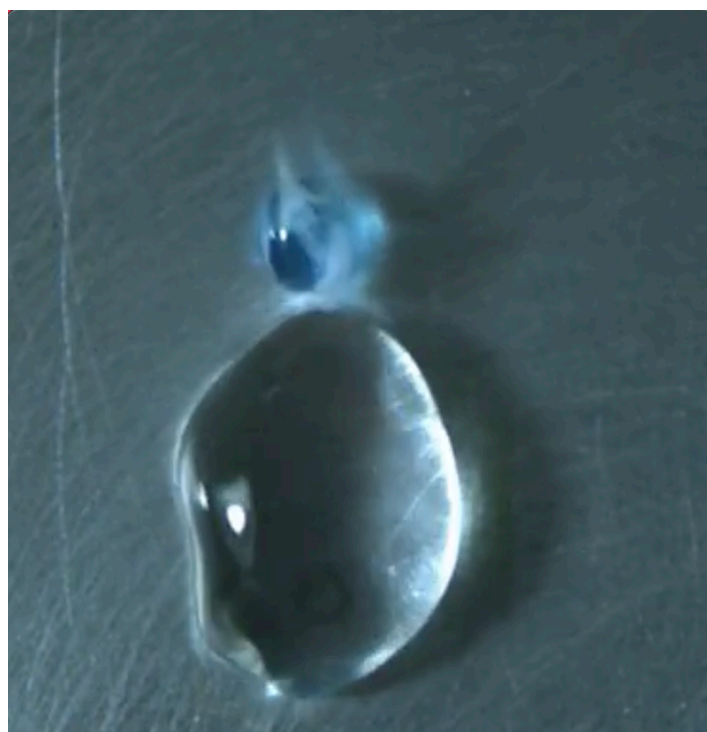
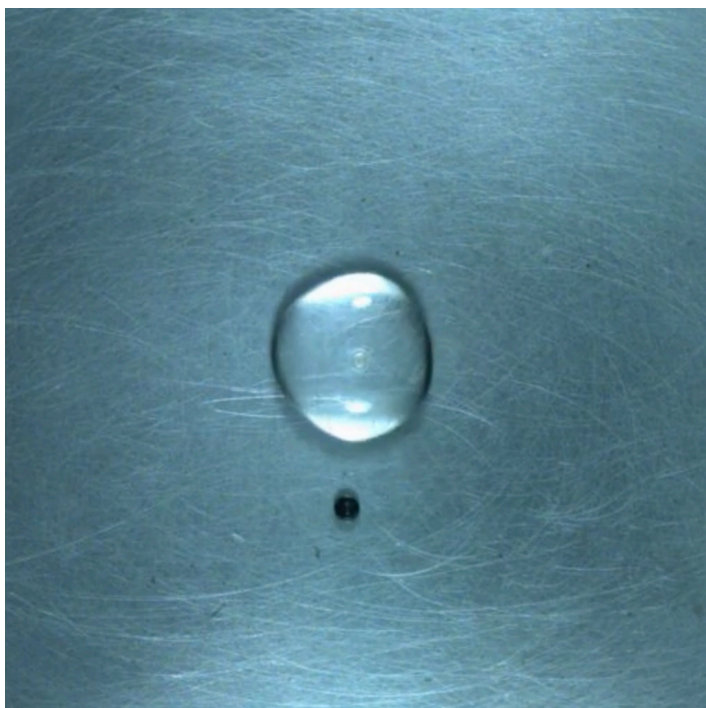


Bouncing Droplets Reveal New Leidenfrost Effect

Droplets floating on vapor cushions can bounce off each other when they are composed of different liquids.

By David Ehrenstein

Sprinkle some water on a sufficiently hot pan, and the droplets skitter across the surface, insulated from rapid boiling by a layer of water vapor upon which they float. New experiments show that this “Leidenfrost” effect can occur between two droplets of differing liquids [1]. A gas layer



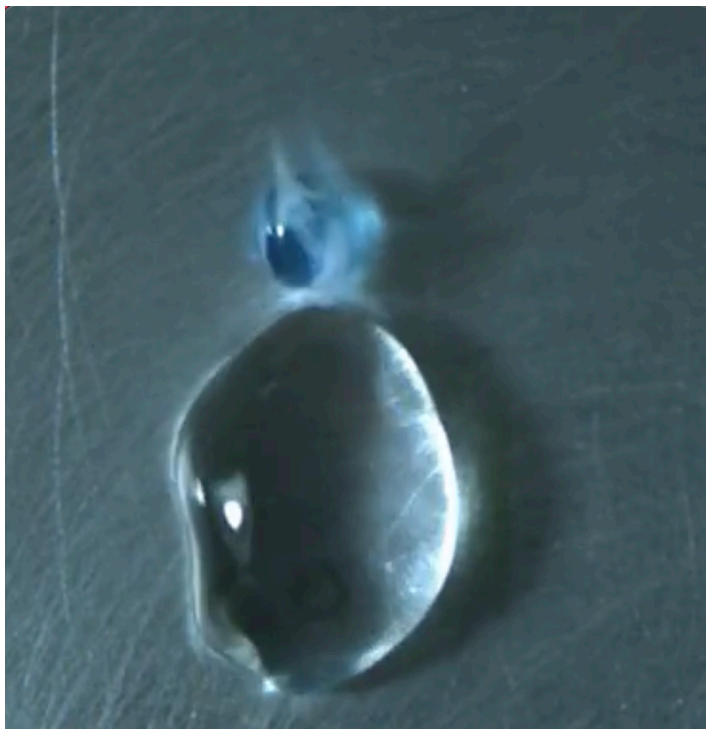
Ethylene glycol (clear) and chloroform (blue) have such different boiling points that the vapor layer between the droplets is visible when they collide.

Credit: F. Pacheco-Vázquez *et al.* [1]

An ethanol droplet bounces around a water droplet before eventually merging. The temperature of the concave metal surface is 250 °C.

Credit: F. Pacheco-Vázquez *et al.* [1]

develops between the droplets, causing them to bounce off each other for seconds or minutes before finally merging. The researchers behind the experiments say that their work could help improve understanding of the interactions of fuel droplets with hot engine surfaces.



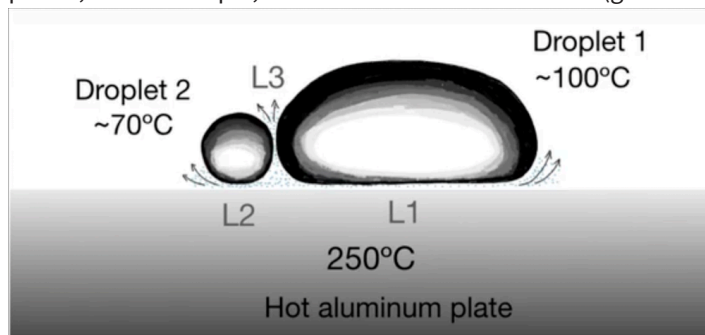
When droplets of ethylene glycol and chloroform merge, the chloroform droplet explodes because its boiling point ($54\text{ }^{\circ}\text{C}$) is so much lower than that of ethylene glycol ($190\text{ }^{\circ}\text{C}$).

Credit: F. Pacheco-Vázquez *et al.* [1]

In the experiments, performed by Felipe Pacheco-Vázquez of the Autonomous University of Puebla, Mexico, and his colleagues, the researchers used a metal plate with a slightly concave top surface and heated it to $250\text{ }^{\circ}\text{C}$. They placed a series of water droplets onto the surface and observed them merging into a blob at the lowest point in the center. However, when the team added an ethanol droplet, it did not immediately merge but instead bounced many times against the larger water droplet. Based on results from ten different liquids, the team suggests that the rebounds are caused by a vapor layer between droplets, similar to the one that each

droplet produces underneath itself. According to this theory, there are three separate Leidenfrost layers involved in the two droplets, so the researchers call it a “triple Leidenfrost” effect.

In these conditions, the liquids are essentially at their boiling points, so for example, water would be at about $93\text{ }^{\circ}\text{C}$ (given the



Too hot to merge. Two droplets on a sufficiently hot surface will float on vapor cushions (L1 and L2). The new experiments show that two droplets of different fluids can also form a vapor boundary between them (L3) when their boiling temperatures are different enough.

Credit: F. Pacheco-Vázquez *et al.* [1]

altitude of the lab in Puebla, Mexico) and ethanol at about $72\text{ }^{\circ}\text{C}$. This large temperature difference can generate a Leidenfrost layer between droplets. Eventually, however, the more rapidly evaporating ethanol droplet becomes so small that it can't generate enough vapor to withstand the attraction to the water. In other cases, when the difference in boiling points is too small for a Leidenfrost effect between droplets, they merge without any bouncing.

David Ehrenstein is a Senior Editor for *Physics*.

REFERENCES

1. F. Pacheco-Vázquez *et al.*, “Triple Leidenfrost effect: Preventing coalescence of drops on a hot plate,” *Phys. Rev. Lett.* **127**, 204501 (2021).