Thermal antibubbles

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Antibubbles are ephemeral objects composed of a liquid drop encapsulated by a thin gas shell immersed in a liquid medium, as illustrated in the inset of Fig. 1. When the drop is made of a volatile liquid and the medium is superheated, the gas shell inflates at a rate governed by the evaporation flux from the drop. This thermal process represents an alternate strategy for delaying the antibubble collapse. We model the dynamics of such 'thermal' antibubbles by incorporating to the film drainage equation the heat-transfer-limited evaporation of the drop, which nourishes the gas shell with vapor, as for Leidenfrost drops. We demonstrate that the inflation of the gas shell is drastically inhibited by the thermalization of the initially colder drop. Because of this thermalization effect, smaller drops evaporate much faster than larger ones. More details in this reference[1]

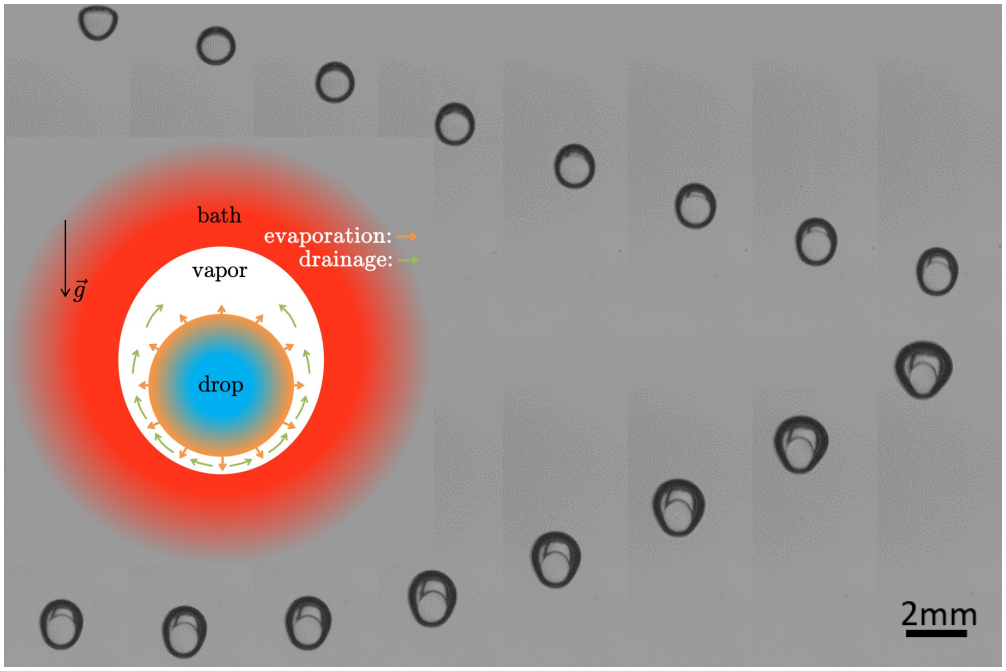

Figure 1: Snapshot series every 24 ms presenting the motion of a thermal antibubble made of an HFE7100 drop released into a bath of V20 silicone oil heated at $T_b = 120\,^{\circ}\mathrm{C}$. The change of direction occurs 206 ms after the first image, *i.e.* between the 9$^{\text{th}}$ and the 10$^{\text{th}}$ snapshot. The inset shows schematically how in thermal antibubble, the heat provided by the hot bath (in red) is used for both evaporating and thermalizing the initially cold drop. (in blue). The generated vapor, while draining from the bottom to the top, delays the antibubble collapse.

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[1]Miguet et al., *Physical Review Letters* **131** (2023).