Chair: Physics of Fluids group

Dynamics of multiple super-heated microdroplets

Description

Intumescent coatings are state-of-the-art fire protection resins, that are now extensively applied on steel construction. Upon exposure to fire, these coating massively generate bubbles (intumescence) and thereby swell before stabilizing in a charred configuration. The effect on heat diffusion is 2-fold: the increased thickness as well as the large gas content. Both severely decrease heat diffusion, which allows saving the construction. Unfortunately, these coatings rely on a chemical process that cannot be further controlled or improved.

Within the physics of fluids group, we are developing a new generation of coatings based on the more controlled and more efficient vaporization of microdroplets embedded in the coating. There remain, however, fundamental hurdles to overcome before such a coating can be constructed. **In this project, you will explore the physical interactions between droplets as they superheat and vaporize in a hot oil bath.** Understanding such interactions is critical to this new technology.

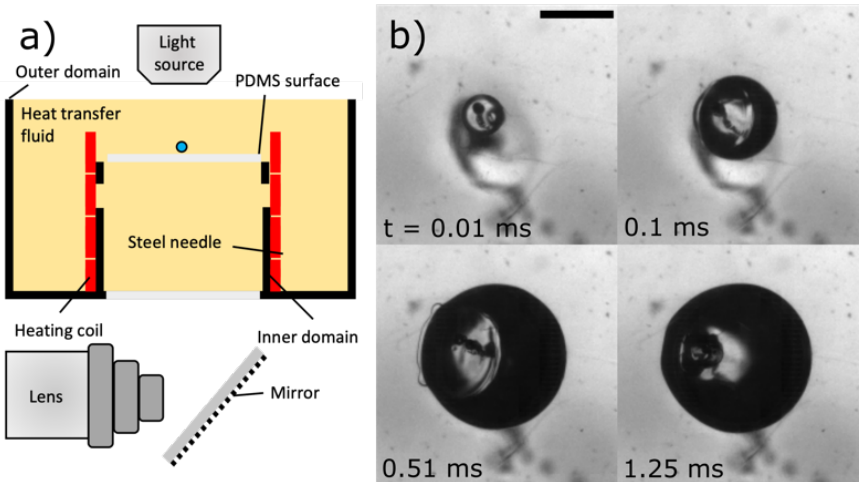

Figure 1. Superheated water-in-oil droplet. a) Sketch of high-speed imaging experimental setup used to capture the bubble generation process. b) High-speed images of bubble evolution. The scale bar represents 1 mm.

Assignment: Multiple droplets vaporization

- Experimental measurements of vaporizing droplets using high-speed imaging.
- Analysis and quantification of the vaporization events (size, dynamics, successive events, temperature,...)
- Understand the theory that governs the dynamics, the role of different time scale in the formation of vapor bubble until complete vaporization of the droplet.

Keywords: Phase-change dynamics, Superheated droplets/bubbles, Heat and mass transfer, Vaporization, High-speed imaging, Image processing, Particle tracking velocimetry, High-temperature experiments

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