Chair: Physics of Fluids group

Vaporization dynamics of superheated microcapsules

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 effect of cross-linked polymeric shell on the vaporization of encapsulated microdroplets as they superheat and vaporize in a hot oil bath**. Understanding the physical impact of the stabilizing shell is critical to this new technology.

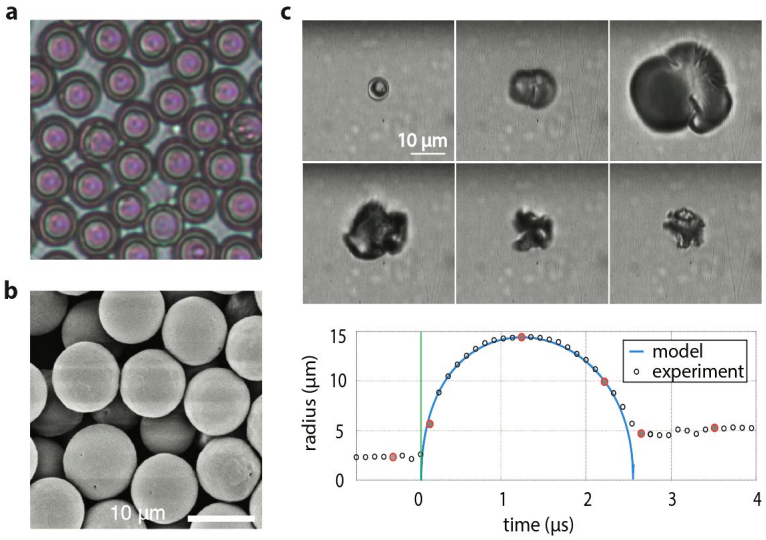

Figure 1. a) Bright field and b) SEM images of polymeric microcapsules. c) Top: Ultra-high-speed recording of a vaporizing capsule. Bottom: Evolution of bubble radius, red dots depict the frames of the top panel. (Nature Communications)

Assignment

- Production, characterization, and optimization of monodisperse microcapsules.
- Work on the high-speed imaging experiments of microcapsules vaporization and analysis.
- Understand the theory that governs the dynamics of superheated bubbles resulting from an encapsulated droplet.

Keywords:

Vaporization, Superheated microcapsule/bubble, Heat and mass transfer, Phase-change dynamics, High-speed imaging, Image processing, High-temperature experiments, Polymer-based 3D Microfluidics, 3D-printer.

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