Chair: Physics of Fluids group

Colloidal buckling balls

Description

Imagine a spherical liquid droplet containing solid particles. When the liquid evaporates, only the particles are left behind. Interestingly, the way the particles organize depends strongly on their concentration, their number and on the way the liquid evaporated. Under certain conditions, they can assemble in a spherical shape (a colloidal ball), but on other occasions, this ball can become hollow inside, become unstable by its own tension and buckle (see Figure 1), which we call *colloidal buckling balls*. They are typically hollow and could have interesting applications for encapsulation of medicaments or other substances, but their stability is still a mystery to us. In this project, we would like to understand the process leading to *colloidal buckling balls* using experiments and/or simulations.

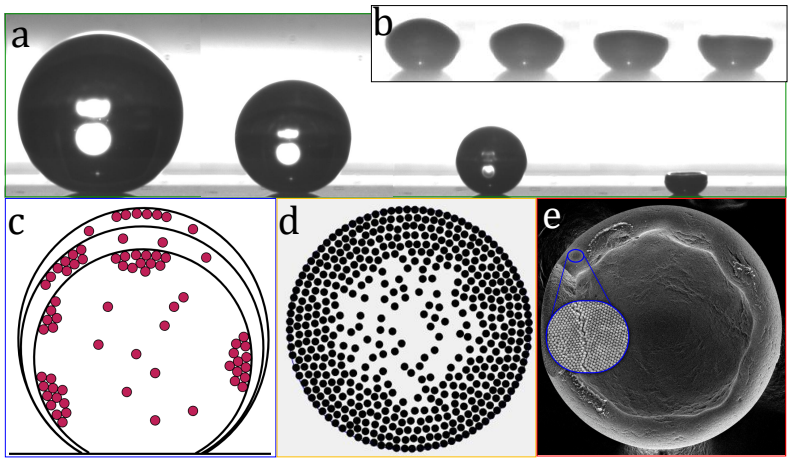

Figure 1: (a) Image sequence showing the evaporation of a droplet on a superhydrophobic substrate containing colloidal particles and the colloidal buckled ball formation. (b) Close-up on the buckling leading to final "cup" geometry. (c) Schematics showing the mechanism leading to particles accumulating at the interface. (d) Simulation snapshot of the shell formation. (e) scanning electron microscope image of a cluster observed from top.

Assignment

The project, should you choose to accept it, has two distinct approaches. As a bachelor student, you would choose one of them for your bachelor assignment. As a master student, we recommend you to attempt both approaches:

- Numerical simulations: you will conduct molecular dynamics simulation of interacting Brownian particles inside a shrinking domain where you will explore the particle shell formation and properties by varying the particle interactions and shrinking rates (see figure 1d),
- Laboratory experiments: you will explore the buckling dynamics for different particle types, different densities, sizes, shapes, etc. The buckling will be visualized from two simultaneous views: top and side, or bottom and side, looking particularly at the final instances (figure 1b), when all the fun happens.

Supervision	E-mail	Tel.	Office	Project room
Raphael Saiseau	r.a.saiseau@utwente.nl	unknown	Meander	Meander
Alvaro Marin	a.marin@utwente.nl	unknown	Meander	Meander