Chair: Physics of Fluids group - Master/Bachelor Project Proposal

Interaction of droplets and colloidal suspensions with an advancing solidification front

The interaction between particles with an advancing solidification front is of great importance in nature and industry and a better fundamental understanding of such processes is desired [1]. To this end, an experimental set-up is designed as shown in figure 1(a). Although we are only at the beginning of this research, remarkable observations have already been made regarding, for example, the interaction of silicone oil droplets with the advancing solidification front and their consequential encapsulation, see figures 1(b)&(c). In addition, preliminary results on the solidification of a colloidal suspension show an intriguing dependency on the velocity of the solidification front, see figure 1(d).

The project proposed here will mainly focus on the last mentioned observation, its experimental continuation and theoretical justification [2] but is by no means set in stone. Dependent on your personal interests or surprising new observations that you might make the focus of the research may shift. Other interesting research topics might for example be the occurring instabilities when freezing very dense colloidal suspensions [3] or binary liquids [4]. Or how particles/droplets/bubbles interact with the solidification front and get encapsulated as a binary liquid solidifies [5].

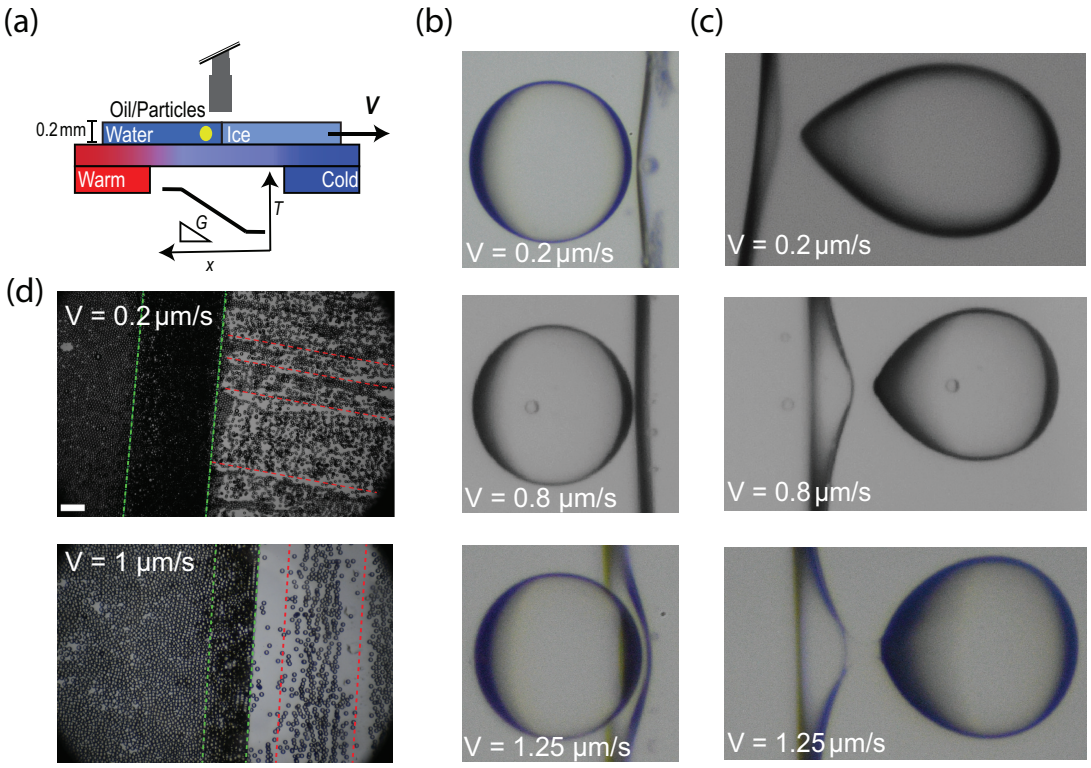

Figure 1: (a) Sketch of the experimental set-up. (b) Deflection of the solidification front as it approaches a silicone oil droplet at different velocities. (c) Deformation of the silicone oil droplet after it encapsulation at different velocities. (d) Freezing of colloidal systems (small polystyrene particles) at two different velocities. Note the change in orientation of the areas the particles tend to avoid after the solidification front has passed.

What to expect

- Close collaboration with your daily supervisor (Jochem)
- A working experimental set-up
- Freedom to choose the direction of the research yourself

What you will learn

- Designing and performing an experiment
- Data analysis, scientific quantification of the data and its theoretical justification
- Presenting and documenting your findings in a good, scientific manner

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References

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[2] S. Peppin, J. Elliott, and M. G. Worster, "Solidification of colloidal suspensions," *Journal of Fluid Mechanics*, vol. 554, pp. 147–166, 2006.

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