Chair: Physics of Fluids group

Production of micron-sized particles and capsules by 3D-printed fully three-dimensional microfluidic channels

Description

Microfluidics is a useful approach to fabricate particles and capsules. In this method, droplets are first produced using a flow-focusing chip (see fig. 1(a)). These droplets are then stirred in a beaker (see fig. 1(b)). Depending on the reagents used, particles or capsules are made. This is an attractive method as the production rate can be high and the particle/capsule properties can be fine-tuned relatively easily. However, the flow-focusing chips are typically two-dimensional and are costly, which limits the accessible parameter range.

In this project, you will therefore design and print three-dimensional microfluidic channels to produce micron-sized particles/capsules over a wide range of parameters such as densities and sizes. You will also optimize the process by understanding the important variables that control their size, shape, and structure. The particles you produce will be used in research on turbulence, such as bubble–particle collisions in turbulent flow. The second time, you will produce microcapsules in improved intumescent coatings used for passive fire protection. The coating swells when exposed to fire, acting as a thermal insulator and preventing the structure from melting.

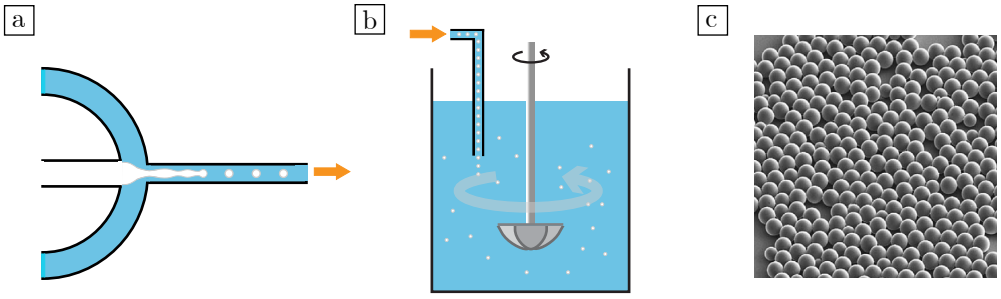

Figure 1: (a) Producing uncured droplets with a microfluidic chip. (b) Droplets are being stirred in a beaker to be cured into particles or capsules. (e) SEM image of nearly neutrally buoyant particles [1].

Assignment

In this experimental project, you will (can be adjusted depending on your interest)

1. design and manufacture 3D microfluidic channels by 3D printing,
2. make fluorescent particles and capsules with a range of properties using the microfluidics channels,
3. characterize particles/capsules by measuring their monodispersity, size, shape, and structure,
4. study the effect of the flow parameters on the optimization of particles/capsules production.

If you have any questions, please feel to contact Timothy Chan (t.k.t.chan@utwente.nl) or Saeed Saleem (m.s.saleem@utwente.nl).

Supervision	**E-mail**	**Tel.**	**Office**	**Room**
Timothy Chan	t.k.t.chan@utwente.nl	053 489 4069	Meander 247	Meander 247
Saeed Saleem	m.s.saleem@utwente.nl	053 489 1590	Meander 114a	Meander 114a
Dominik Krug	d.j.krug@utwente.nl	053 489 1590	Meander 251	Meander 251
Guillaume Lajoinie	g.p.r.lajoinie@utwente.nl	053 489 4213	Meander 214c	Meander 214c

Reference

[1] M. R. Böhmer, R. Schroeders, J. A. M. Steenbakkers, *et al.*, "Preparation of monodisperse polymer particles and capsules by ink-jet printing," *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, vol. 289, no. 1, pp. 96–104, 2006.