Evaporative Drying of Droplets and the Formation of Microstructured and Functional Particles and Films

"Drying Droplets"

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Aim of project

* Develop a predictive understanding of droplet drying and how it can be used to produce microstructured particles and thin films both in manufacturing processes and in end-use applications.
* Droplets drying in free space and on surfaces
* Single droplets, pairs of droplets, process scale
* Experiment, theory and modelling

Laundry **Agrochemicals**

Printing **Coatings** **Pharmaceuticals**

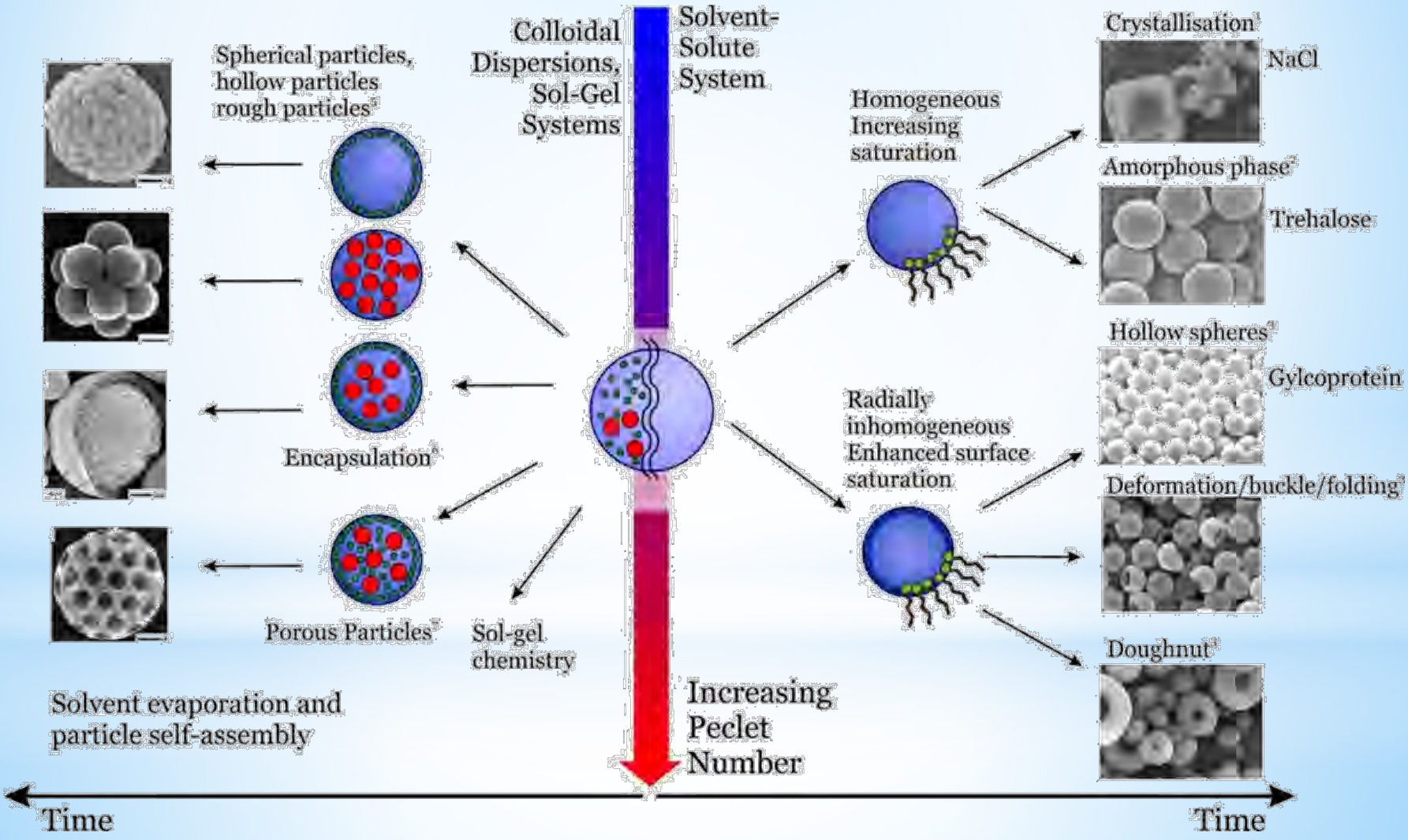
Food **Personal care**

Industry Club

* Centre for Process Innovation
* Procter and Gamble
* AkzoNobel
* Bristol Myers Squibb
* Merck
* Chiesi
* Aptuit
* Croda
* Syngenta
* Sun Chemical
* Inca Digital
* Nutricia
* Nestlé

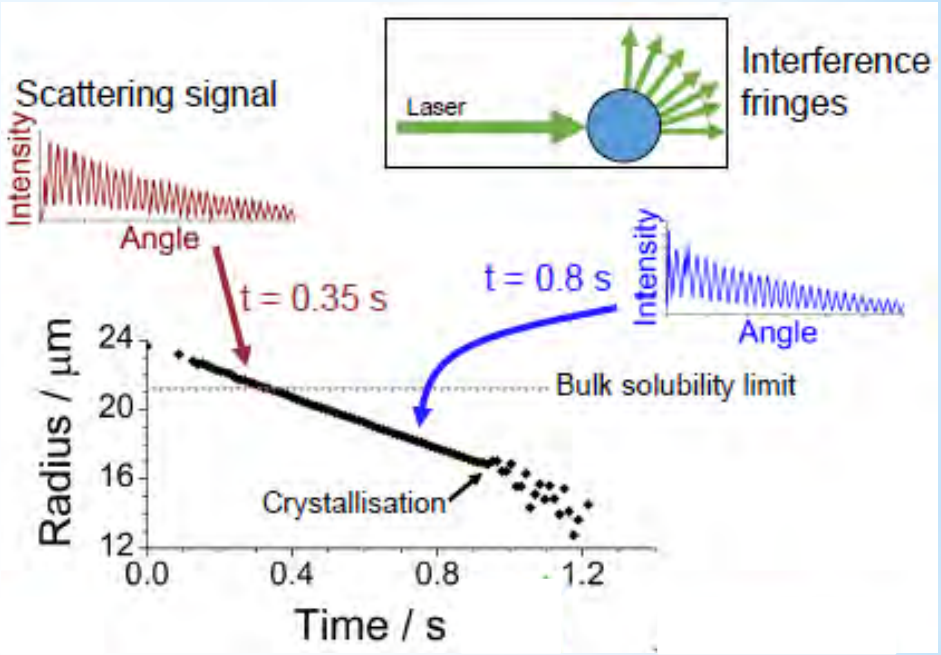
+ accession mechanism for new companies

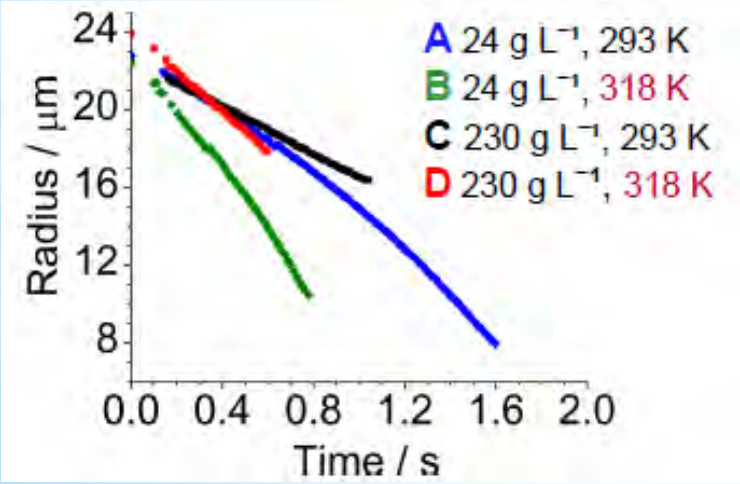
Single drop drying



Isolated droplets

- Trap ~ 50 mm droplet in electrodynamic balance
- Measure radius from interference fringes in scattered light
- Observe point at which crystallisation occurs





Data for sodium chloride solutions

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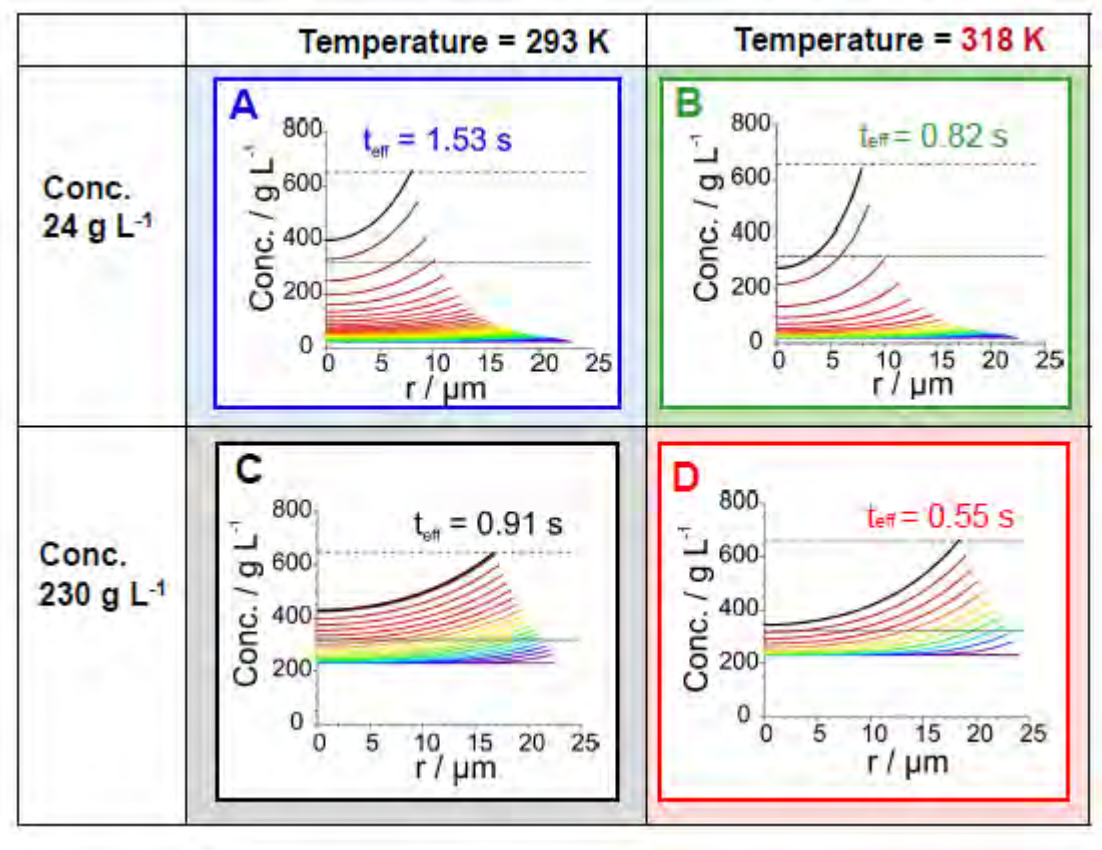
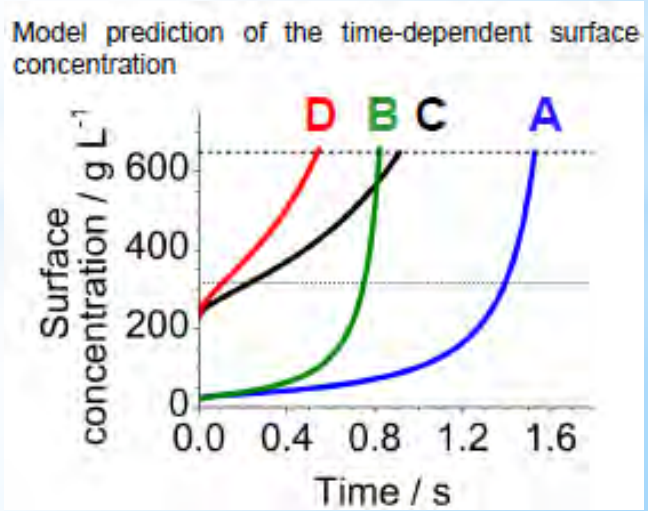
Bristol

Isolated droplets



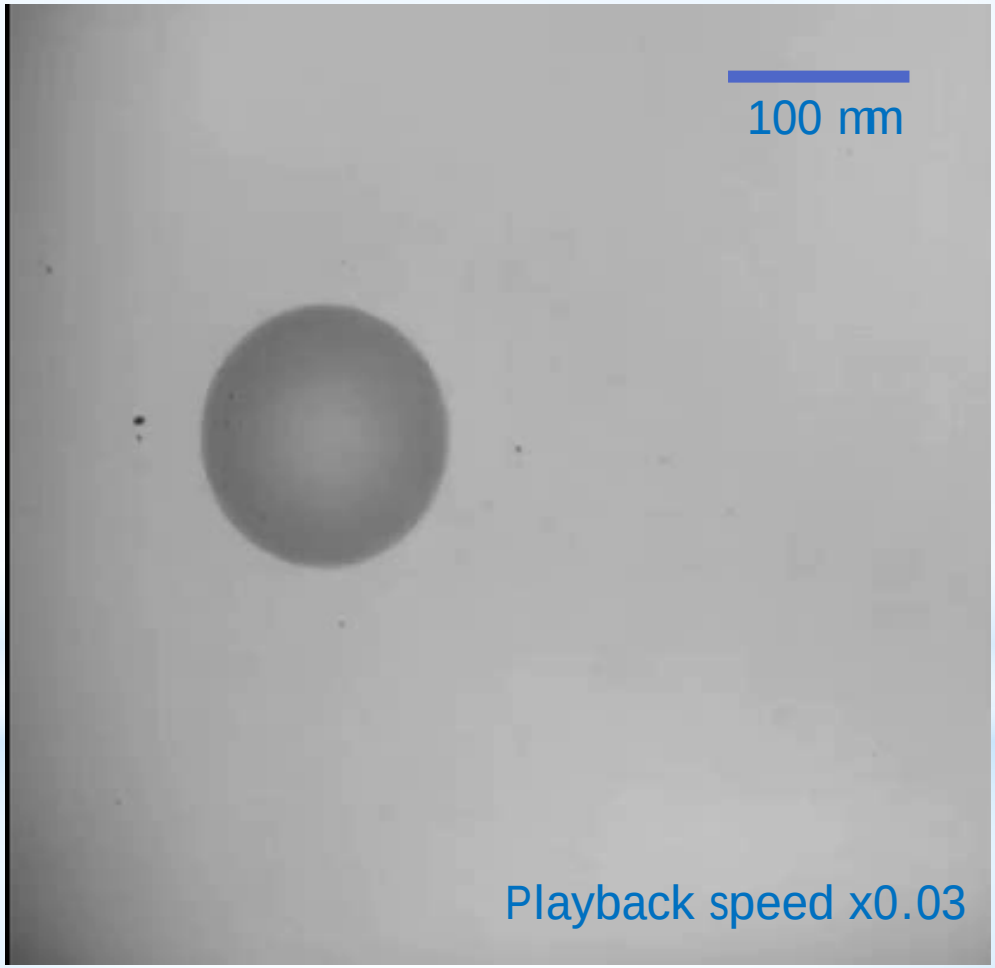
- Solve convection-diffusion equation
- Crystallisation occurs when supersaturation reaches 2.04
- Crystals nucleate at the surface



Compare predictions with experiment to show model works

Droplet interactions on surface

Print two identical 50-mm droplets on glass substrate with a time delay



30% ethylene glycol, 70% water, 800 ms delay

Lisong Yang
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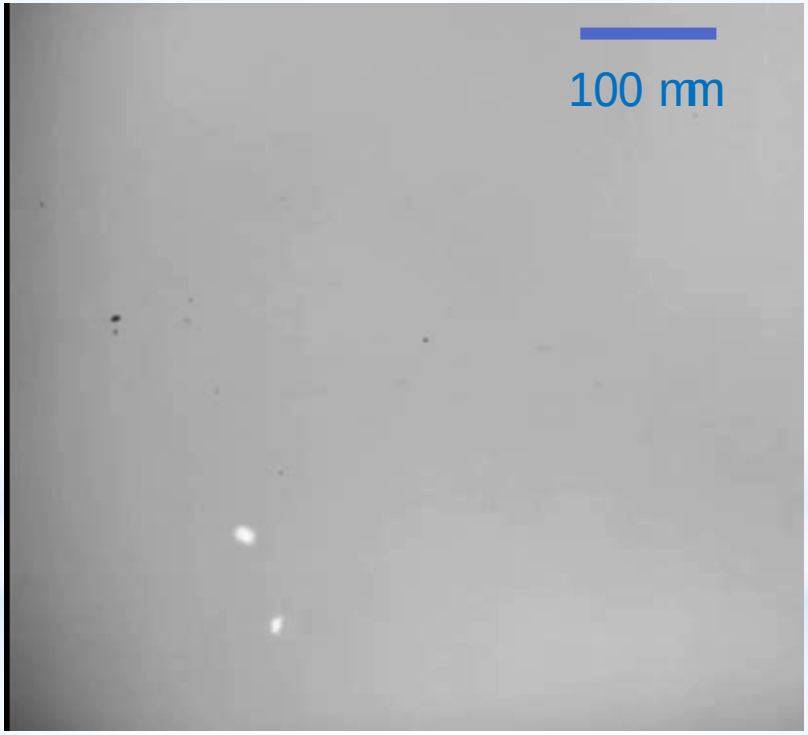
Droplet interactions on surface

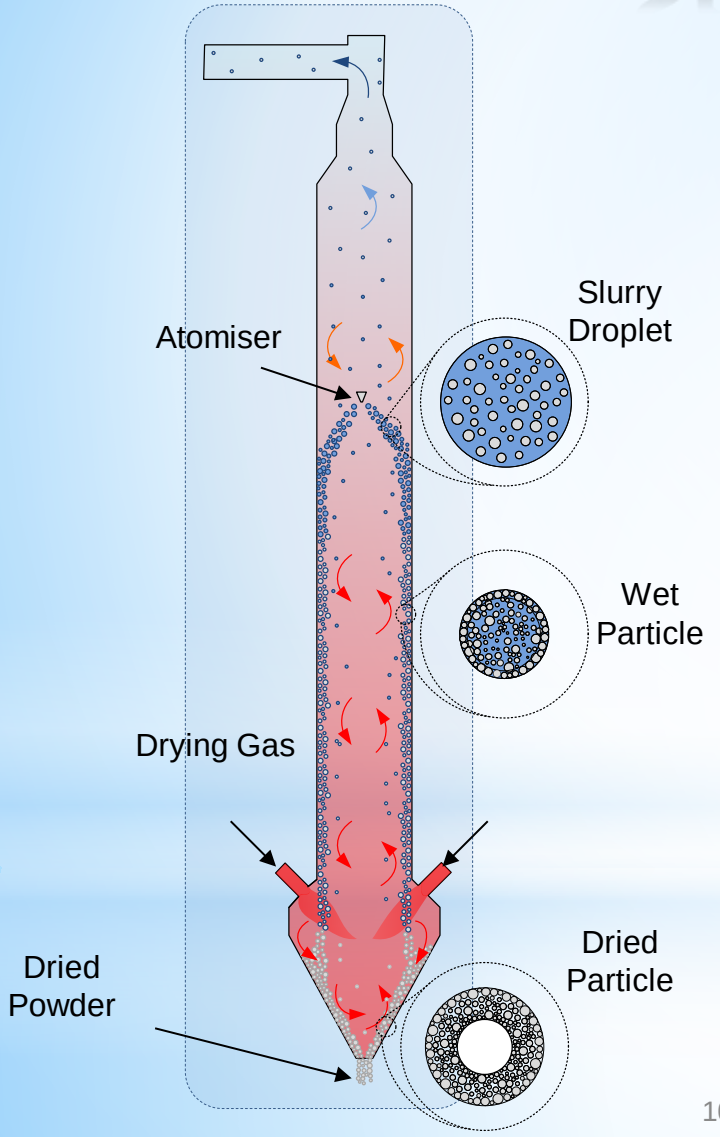
Change delay and get very different behaviour



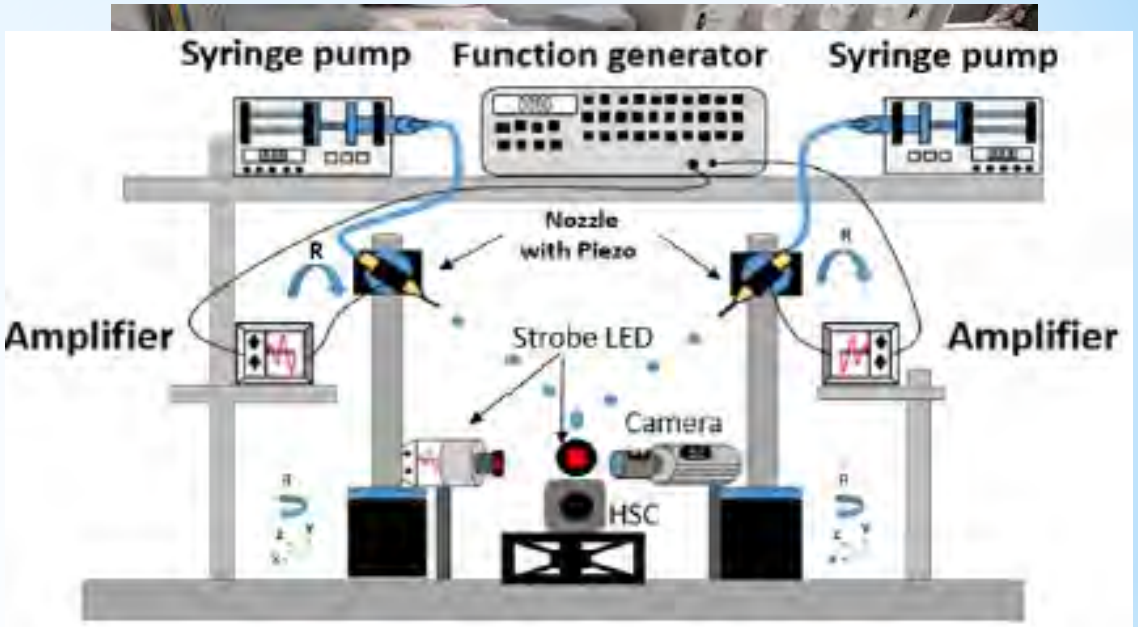
Playback speed x0.03

30% ethylene glycol, 70% water, 100 ms delay

Spray drying



spray drying



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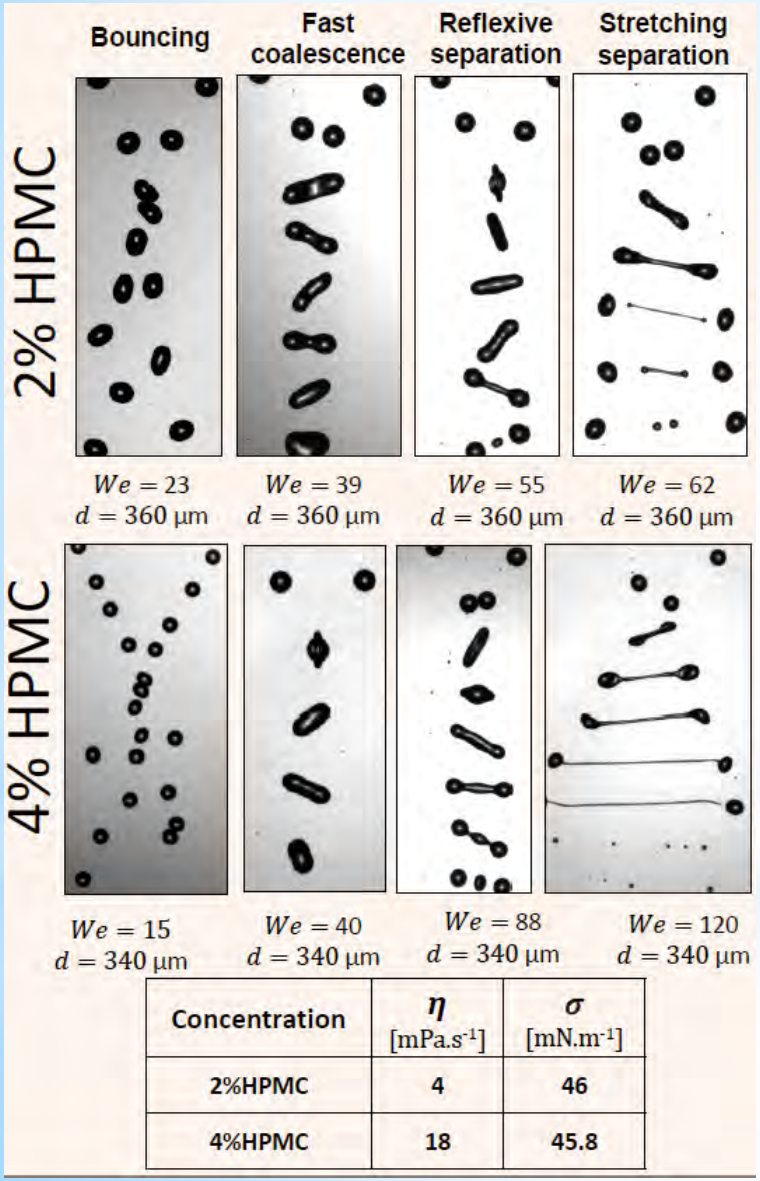
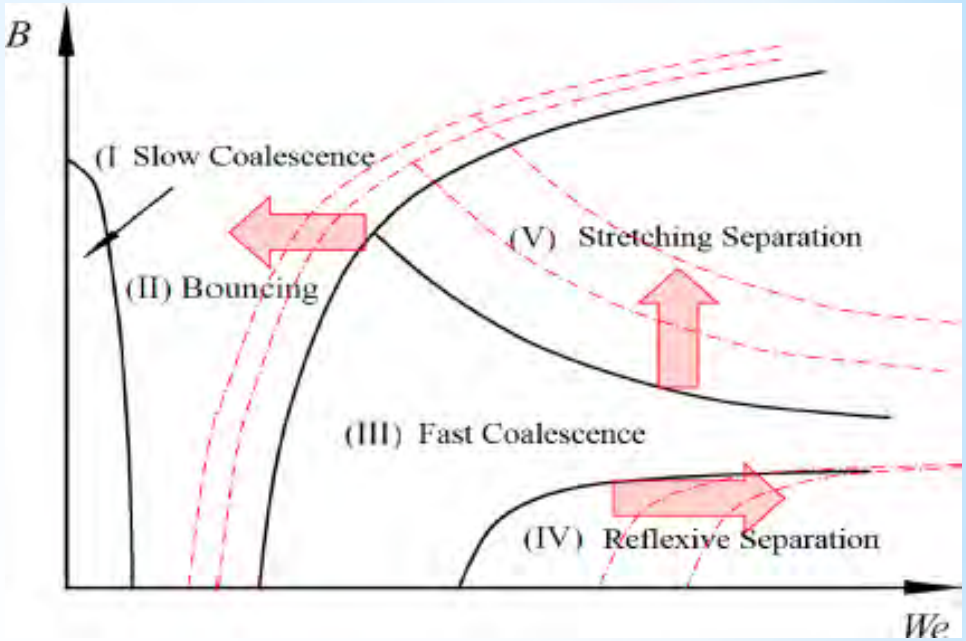
Coalescence mechanisms



Concentration	η [mPa.s^{-1}]	σ [mN.m^{-1}]
2%HPMC	4	46
4%HPMC	18	45.8



B = impact parameter
= distance of nearest approach of drop centres

$$We = \frac{r\,du_r^2}{s}$$