Self-shaping as a Route for Control of Drop Size and Dispersions Rheology

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The design of disperse systems with controlled drop size, morphology, and rheology is crucial in the production of foods, cosmetics, and pharmaceuticals with desired characteristics. A particularly promising route involves the spontaneous self-shaping of droplets, first described in detail by Denkov et al. [1, 2], which enables the formation of lipid particles with regular, non-spherical shapes. Building on this foundation, we present an efficient self-emulsification procedure based on one or more freeze–thaw cycles of predispersed lipid droplets in a coarse oil-in-water emulsion. During these thermal cycles, the frozen droplets spontaneously burst into hundreds or thousands of smaller droplets without the need for mechanical agitation [3]. The resulting non-spherical droplet morphologies significantly influence dispersion rheology: gel-like, non-flowing systems can be obtained even at low oil volume fractions when the emulsions polydisperse droplets. Furthermore, we demonstrate that the optimal drop size range is d_{32} ≈ 4-13 μm for achieving such rheological behaviour. The obtained results are explained through a mechanistic framework, and guiding principles are provided for preparing emulsions with increased viscosities using this new approach. [4]

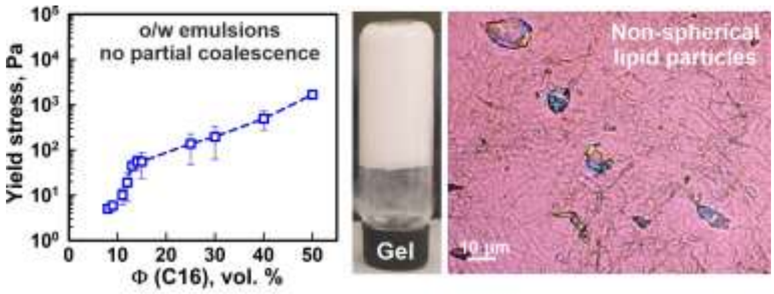

Figure 1. The presented figure illustrates: yield stress of O/W emulsions stabilized by non-ionic surfactants as a function of the oil concentration, picture of a bulk sample stored at 5°C and microscopy image showing non-spherical frozen particles present in sample with 11 vol. % oil at 5°C. Scale bar = 10 μm.

References

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[2] D. Cholakova et al., *ACIS*, **2016**, 235, 90 – 107, doi: 10.1016/j.cis.2016.06.002
[3] S. Tcholakova et al., *Nature Com.,* **2017**, 8, 15012, doi: 10.1038/ncomms15012
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