Controlling foam ageing in viscoelastic media

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ABSTRACT

Foams are dispersions of gas bubbles in a continuous medium. Their typical cellular structure lends them lightness and peculiar mechanical properties that are exploited in many industrial applications. However, liquid foams are only meta-stable systems, as they usually undergo a competition between different mechanisms which alter their internal structure over time. Drainage, coalescence and coarsening can be a strong limitation in industrial processes, as they slowly lead to an irreversible foam damage. The desired longevity of a foam clearly depends on the specific applications, that still call for a thorough understanding of foam stability. We study how the mechanical properties of the continuous phase impact on the coarsening process, in conditions where drainage and coalescence can both be neglected. We control the mechanical properties by using oil-in-water emulsions as the continuous phase of foams. In fact, at sufficiently high droplet concentrations, emulsions show an elastic behaviour, thanks to the storage of interfacial energy from droplet deformations. As this elasticity increases with droplet concentration, we can vary the elasticity of the foam continuous phase by simply adjusting the emulsion oil fraction. We study foamed emulsion coarsening in quasi-2D foam systems, which allow to follow the bubble pattern evolution over time through imaging experiments. We show that the elasticity of the continuous phase strongly influences the ripening of foamed emulsions, leading to reduced bubble growth rates. Moreover, we show that emulsion viscoelasticity also affects the foam structure, with the appearance of unrelaxed bubble patterns. The results can lead to a more efficient control of the foam structure and stability.

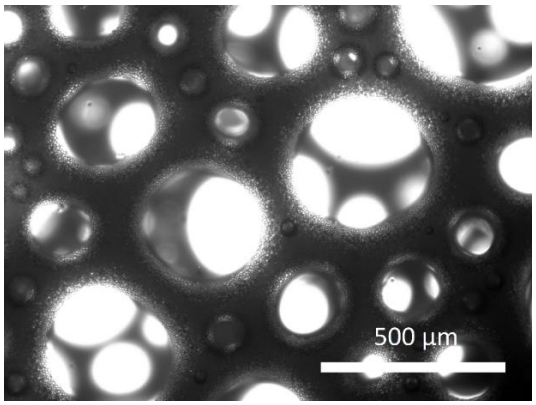

Figure 1: example of a foamed emulsion seen under the microscope.