Foam coarsening in a viscoelastic fluid

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Many soft matter materials evolve through surface tension driven phase separation. During this process the growth of domains can occur via material transfer through the continuous phase. A particular example is foams, which coarsen as gas diffuses between bubbles due to differences in Laplace pressure. In aqueous foams coarsening leads to a characteristic growth of the bubble size, and an accompanying rearrangement dynamics.

However, in many industrial products and processes the continuous phase is not a Newtonian fluid, but a viscoelastic one, such as a paste or a gel. Such foams typically have longer life-times, as the foam ageing processes are slowed down.

We are interested in understanding the role of a viscoelastic continuous phase on foam ageing, and in particular foam coarsening. We study the temporal evolution of foams made from concentrated emulsions. The behaviour of our foams is no longer dominated by capillary effects, but by the rheological properties of the emulsion between the bubbles.

We show that the yield stress of the continuous phase impacts both the foam dynamics and its structural evolution leading to spatially heterogeneous coarsening, as shown in the photographs in the figure below. The resulting patterns are unlike those observed in aqueous foams [1]. Beyond their importance in the design of foamy materials, the results give a macroscopic vision of phase separation in a viscoelastic medium.

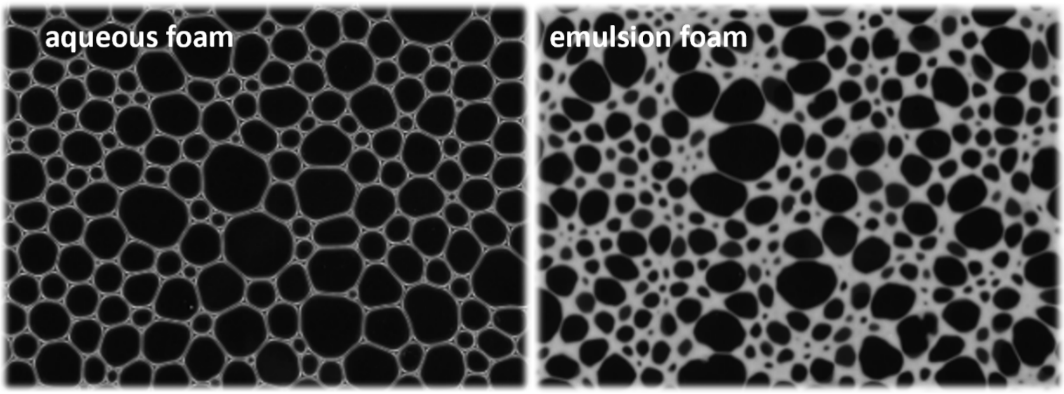

Figure 1 Photographs of quasi-2D foams. On the left a coarsening aqueous foam and on the right a foam with a viscoelastic continuous phase.

[1] Guidolin, MacIntyre, Rio, Puisto, Salonen, Nature Communications 2023.