Flow of Jammed Quasi-two-dimensional Emulsion Droplets

(Talk #2)

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We use quasi-two-dimensional emulsions as experimental models to study the flow of jammed materials. Our emulsions are oil droplets in water and are compressed between two parallel glass plates so that the droplets are deformed into pancake-like disks, as shown in Fig. 1. Using microscopy, we observe these droplets as they flow [1]. From the deformed outlines of the droplets, we can measure all of the inter-droplet forces to within 10% [2]. In this way, we study the relationship between the local stresses in the system and the rearrangements as the sample is sheared. In particular, we find that at very slow flow rates (quasi-static flow), we see large avalanches of rearrangements, whereas at higher flow rates rearrangement events occur more frequently but involve fewer droplets. The simplest rearrangement involves four droplets (a "T1 event") and we confirm theoretical predictions for the quadrupolar spatial pattern of the stress redistribution around the T1 events.

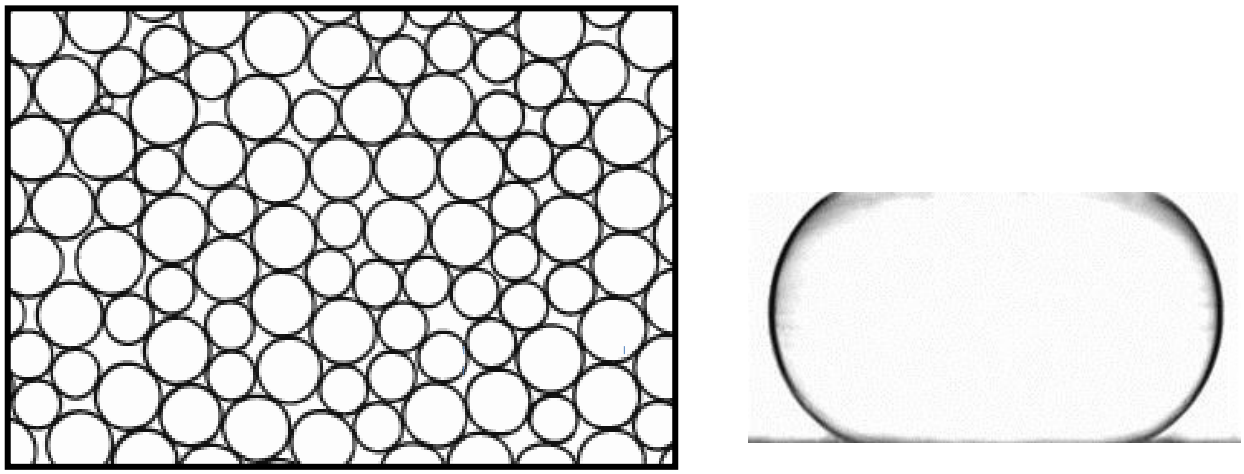

Figure 1. Left: Microscope image of emulsion droplets. The diameters of the droplets are approximately 150 and 220 μm. Right: side image of a single droplet. The image is 500 μm in height, although most of our sample chambers are 100 μm in height.

References:

[1] D. Chen, K.W. Desmond, and E.R. Weeks, Soft Matter 8, 10486 (2012).
[2] K.W. Desmond, P.J. Young, D. Chen, and E.R. Weeks, Soft Matter 9, 3424 (2013).