Force-strain study of 2D soap bubbles

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An original set-up is used to study the mechanics of soap bubbles. Soap bubbles are squeezed between two parallel surfaces and punctually deformed by two needles. The force measurement is carried out by the deflection of a micro-plate. We performed the stretching from single bubbles to multiple bubbles.

For one 2D bubble, we experimentally and theoretically show that its rigidity is inversely proportional to the radius. This allows us to determine the interfacial properties.

For two bubbles in contact, the rigidity of the system under strain is the rigidity of a single bubble with a double radius.

We study experimentally the dynamics of strain-induced T1 neighbor switching in clusters of 2D bubbles (fig 1). At a quasi-static time scale, we show that the T1 transition occurs at the same value of force and strain for different cluster sizes of 4 identical bubbles. The force deformation curves are superposed on a single master curve. The T1 transition for asymmetrical clusters composed of bubbles of various sizes occurs at different values of force and strain whereas the rigidity observed remains the same as for the case of symetrical clusters. The time scale of rearrangement is set by the surface tension, the surface viscous forces and the sizes of the bubbles.

In order to approach to a 2D foam situation, we stretched bigger clusters. After an elastic deformation of these clusters we observed the successive rearrangements at a quasi-constant force value as it had already been observed for a sheared 2D soap bubbles foam [1].

[1] (1) Kabla, A., Scheibert, J., & Debregeas, G. (2007). Quasi-static rheology of foams. Part 2. Continuous shear flow. *Journal of Fluid Mechanics*, *587*, 45-72.

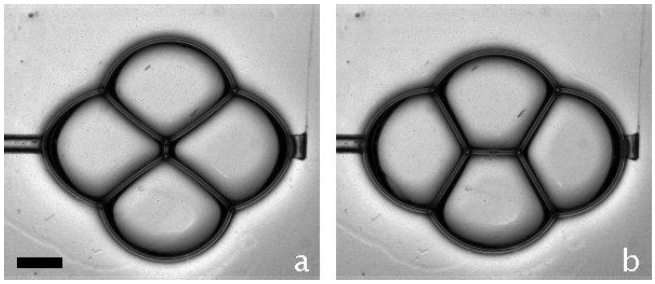

Figure 1 : T1 transition of 4 identical bubble (a. before b. after). The scale bar represents 2cm