Void Propagation in Liquid Foam

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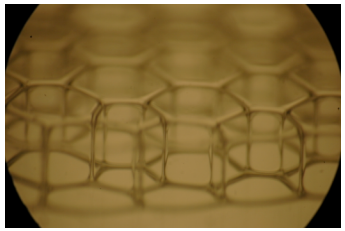
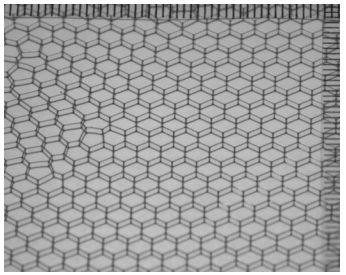
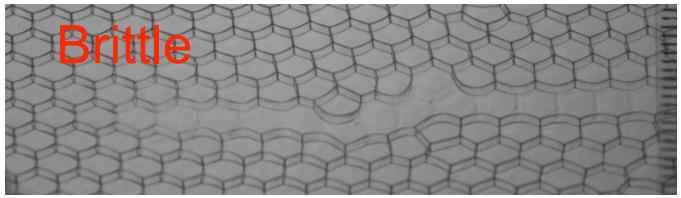


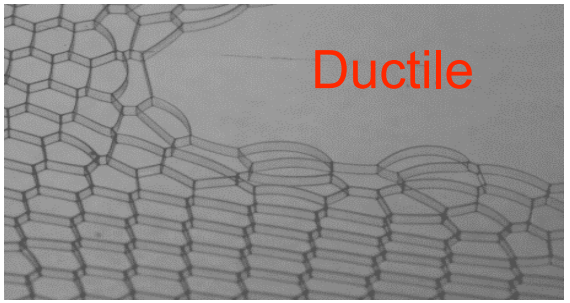
A single layer of bubbles between plates has accessible microstructure and well-defined macroscopic behavior

Macroscopically, it is a viscoelastic material that can both flow like a liquid and break like a solid.

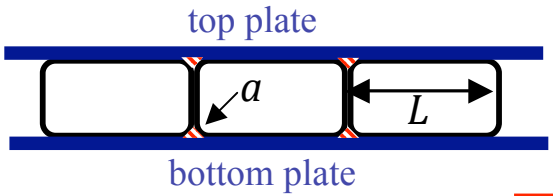




Surprisingly, breaking happens in two ways well-known from atomic solids: brittle and ductile failure
We discovered spontaneous transitions between these states.

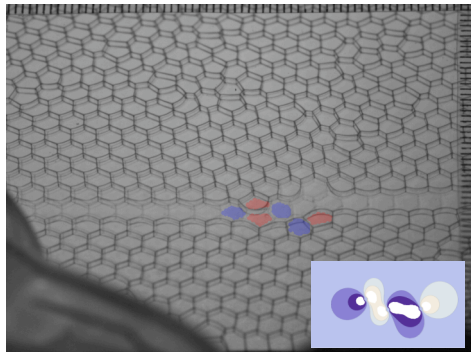


All behavior is governed by the microstructure:



The cross section of bubbles determines viscous resistance…

Crack morphology depends on defect positioning, which changes the stress field in the material (inset)



…and ultimately the speed at which ductile and brittle cracks can propagate.

$$Ca_c = \left(\frac{4a}{4.70L}\right)^{3/2}$$

$$v_c = 0.36\,m/s$$

[Hilgenfeldt, Arif, Tsai, Phil. Trans. Roy. Soc. A, 2008]

Liquid foams model atomic solids closely geometrically and dynamically. We can quantify many features of fracture that are still not understood in metals or rock.