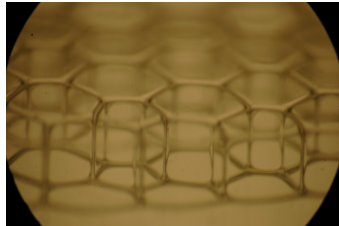


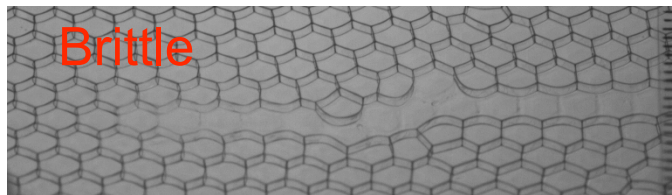
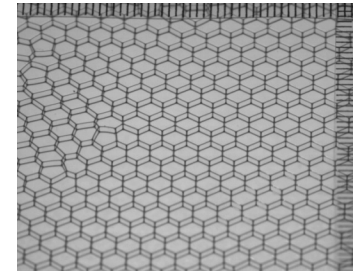
Void Propagation in Liquid Foam

Sascha Hilgenfeldt, *Mechanical Science and Engineering, University of Illinois and Mechanical Engineering, Northwestern University*

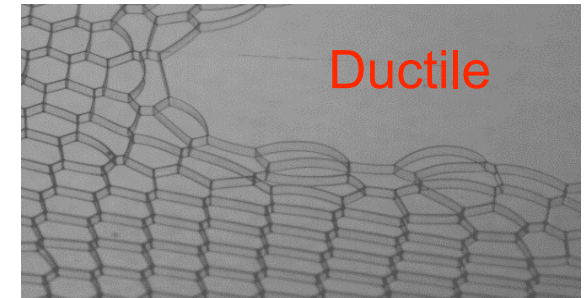


A single layer of bubbles between plates has accessible **microstructure** and well-defined **macroscopic** behavior

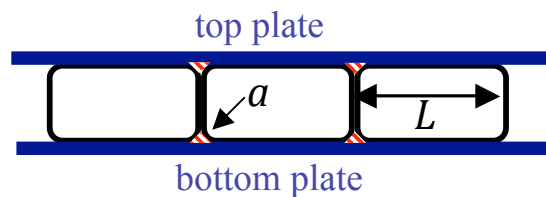
Macroscopically, it is a viscoelastic material that can both flow like a liquid and break like a solid.



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...

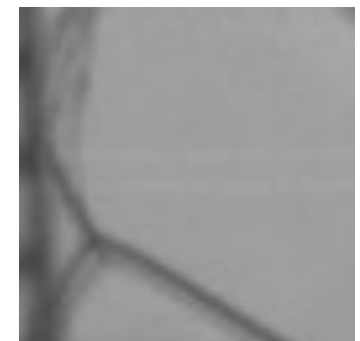
...and ultimately the speed at which ductile and brittle cracks can propagate.

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

$$v_c = 0.36 \text{ m/s}$$

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

Ultrahigh-speed **photography** (>50,000fps) reveals details and mechanisms of **film breakage**, explaining the **large speed of brittle fracture**



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.