

Measuring Strain-dependent Surface Stress in Soft Matter

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Definitions and Motivations

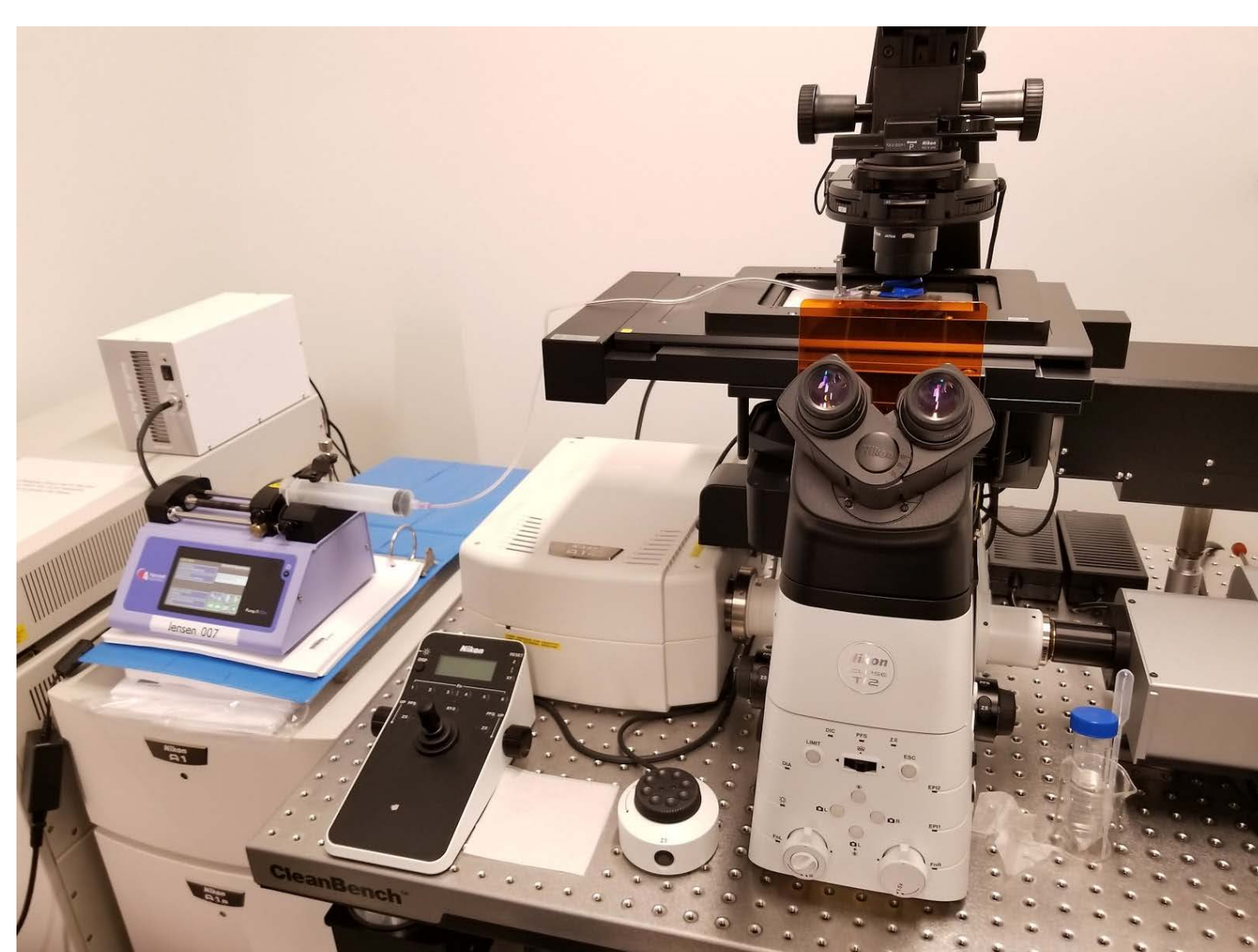
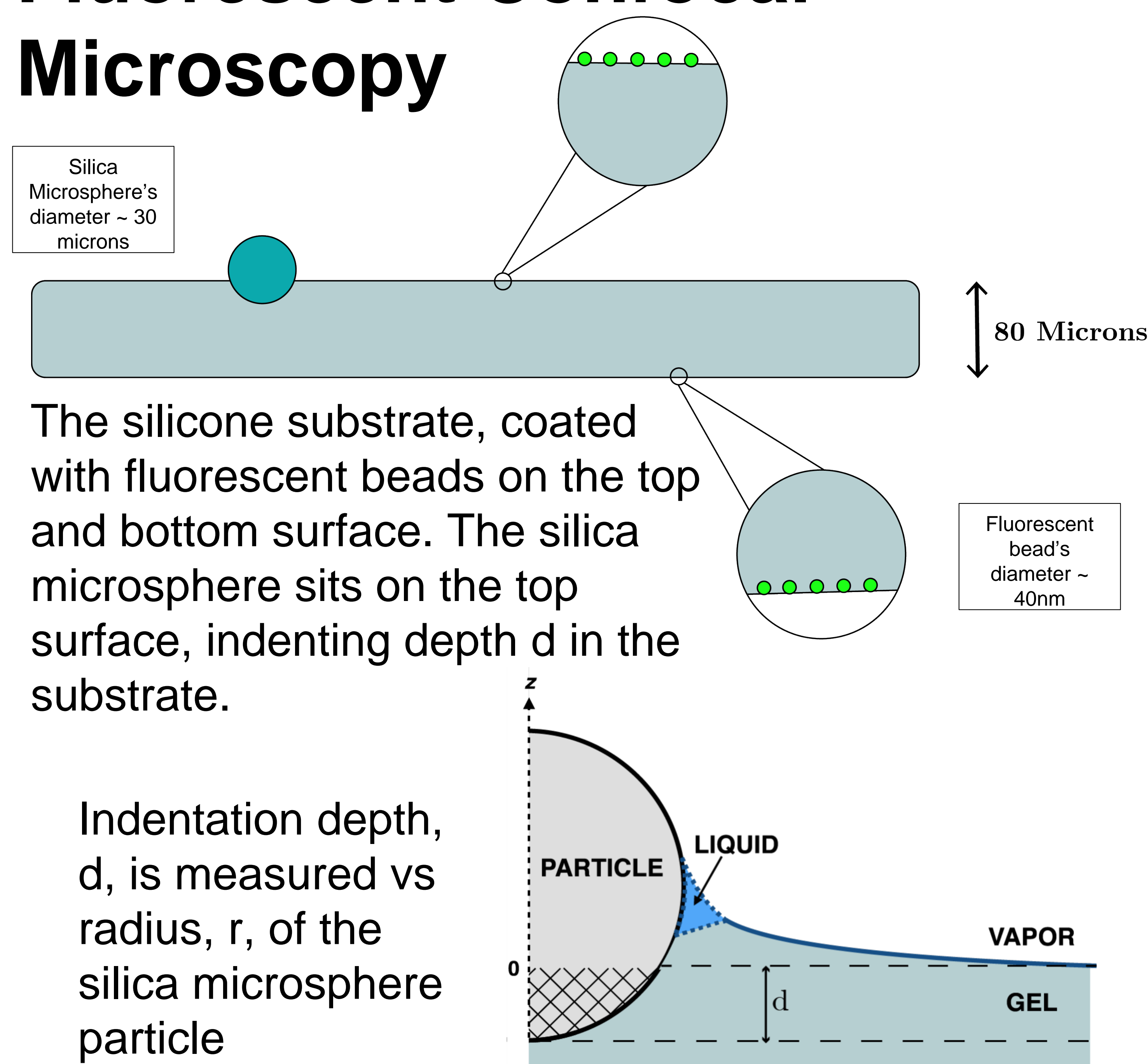
Surface Stress: The amount of work per unit area needed to stretch a material (elastically).

Strain: $\epsilon = \frac{\Delta l}{l_0}$

Gels: Liquids exhibit strain-independent surface tension. Gels are comprised mostly of liquid, so it has been assumed that gels behaved similarly.

2017 Measurement: A 2017 paper (Qin, Jensen, et al. *Nat Comm* 2017) used contact angles to measure strain-dependent surface stress in soft matter.

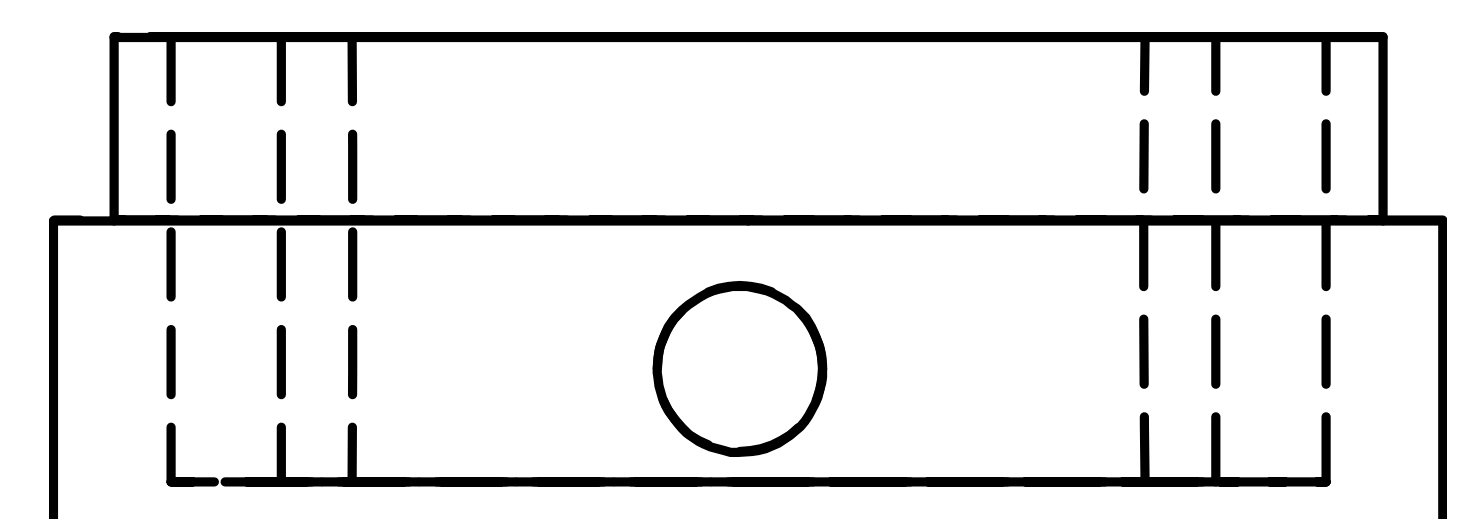
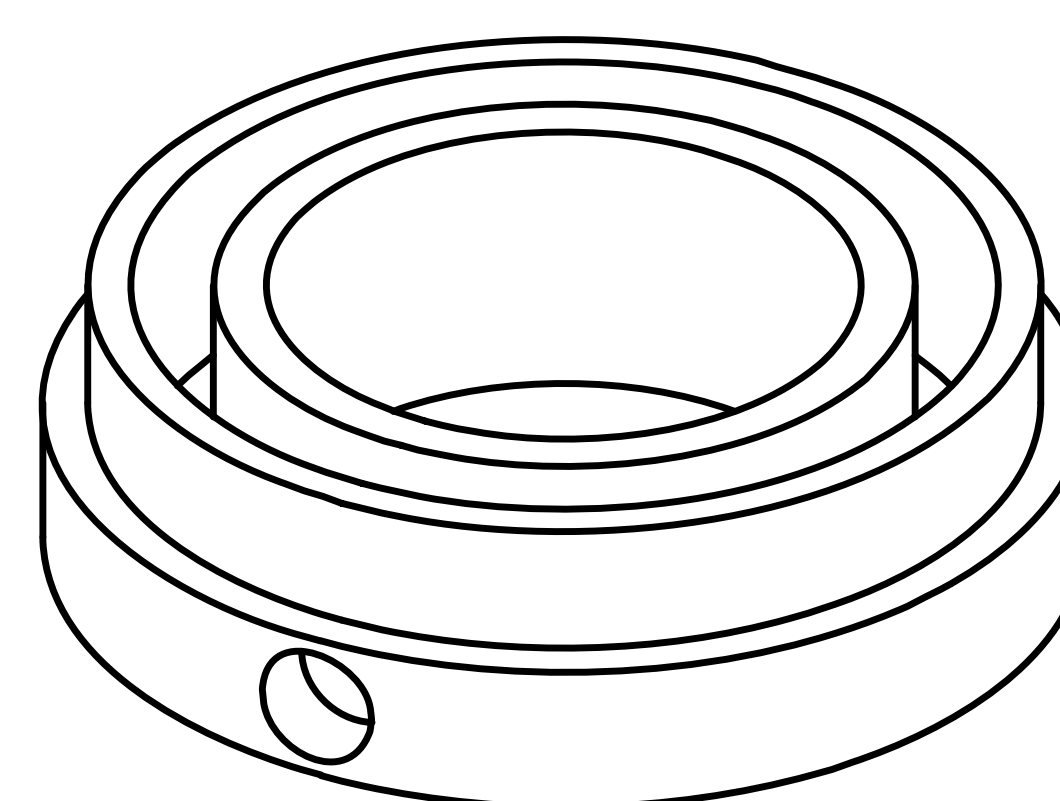
Fluorescent Confocal Microscopy



Confocal Microscope with custom stage insert and syringe pump

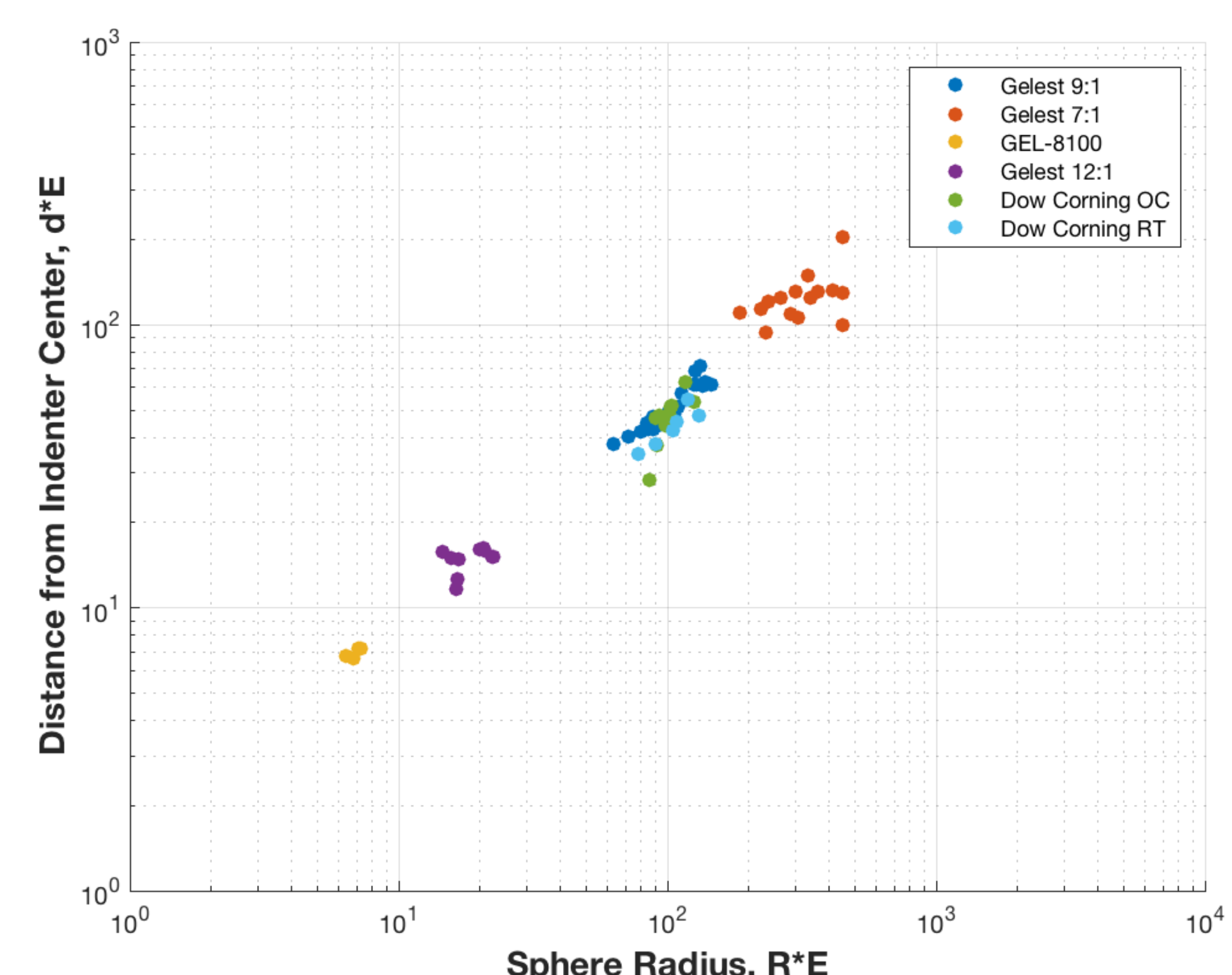
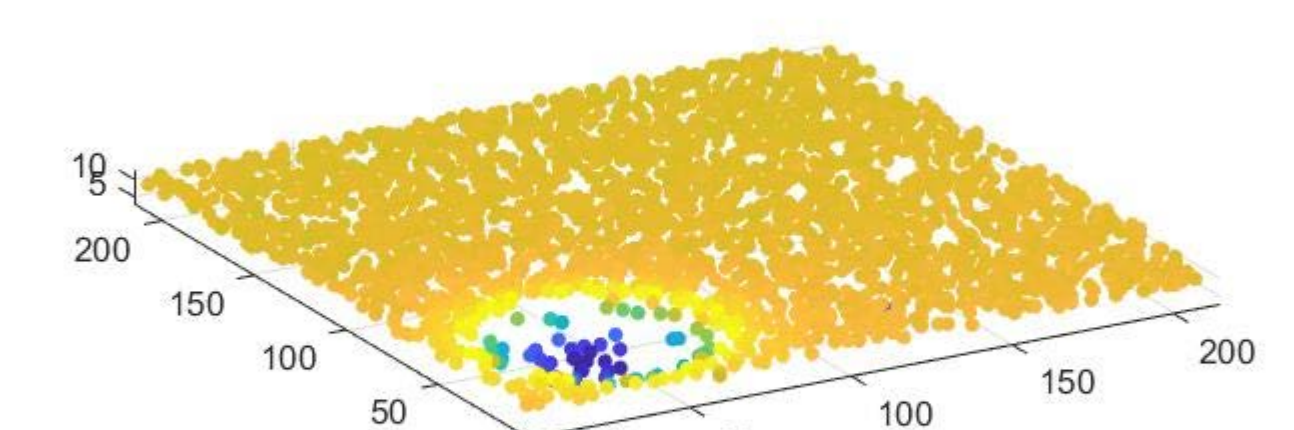
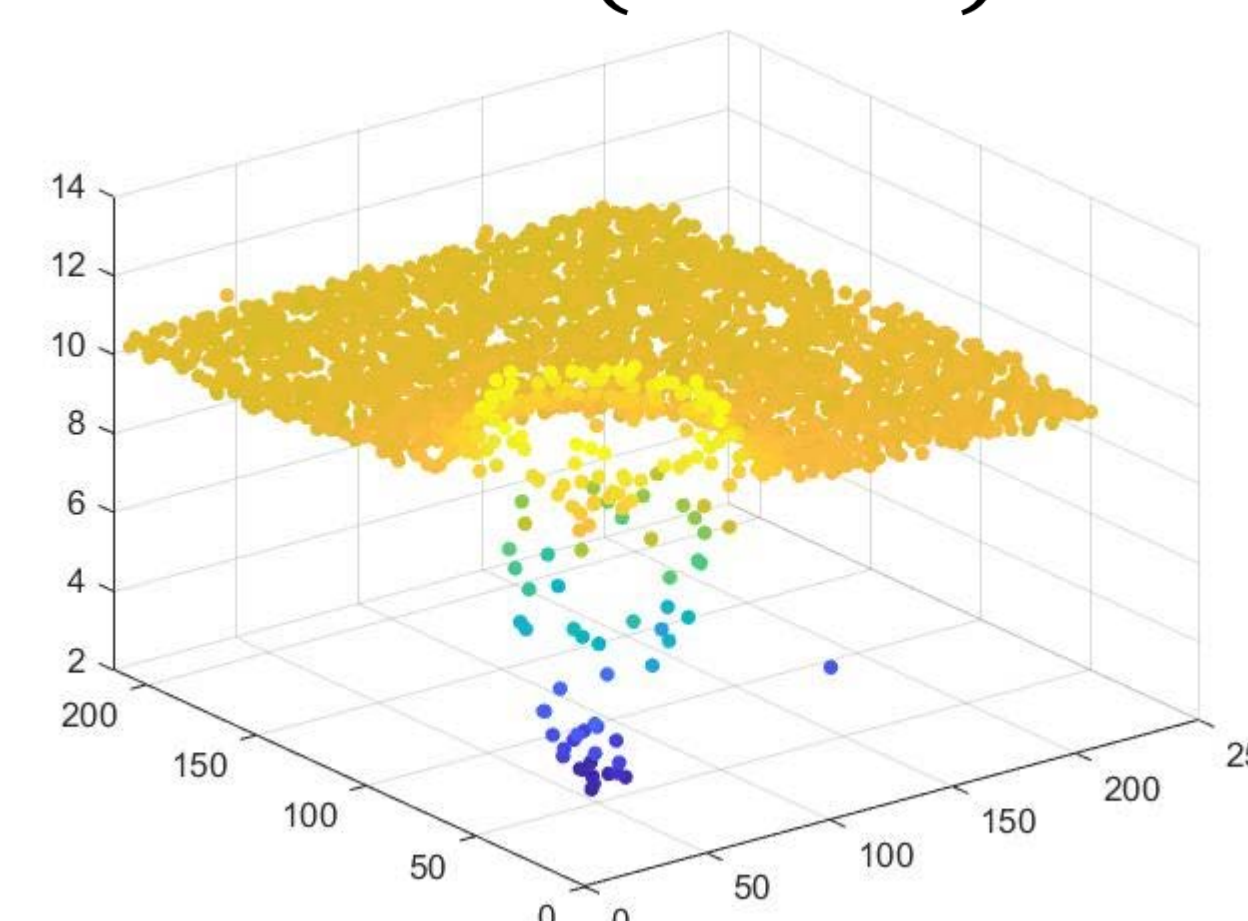
Homogeneous Equi-biaxial Stretching

Homogeneous stretching is achieved using a custom-built stretching apparatus, milled out of aluminum and inset in laser-cut stage insert.



Preliminary Results: d vs R at zero strain with D.C. PDMS

$$\frac{5cER^{1/2}d^{3/2}}{2(1-\nu^2)} + 2\pi\gamma_{sv}d - 2\pi WR = 0$$



Conclusions and Outlook

- Confirm new stretching apparatus is capable of long-term strain hold.
- Collect data and analyze strain dependence of PDMS (Silicone).
- Extend strain-dependent surface stress measurements to other materials.



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