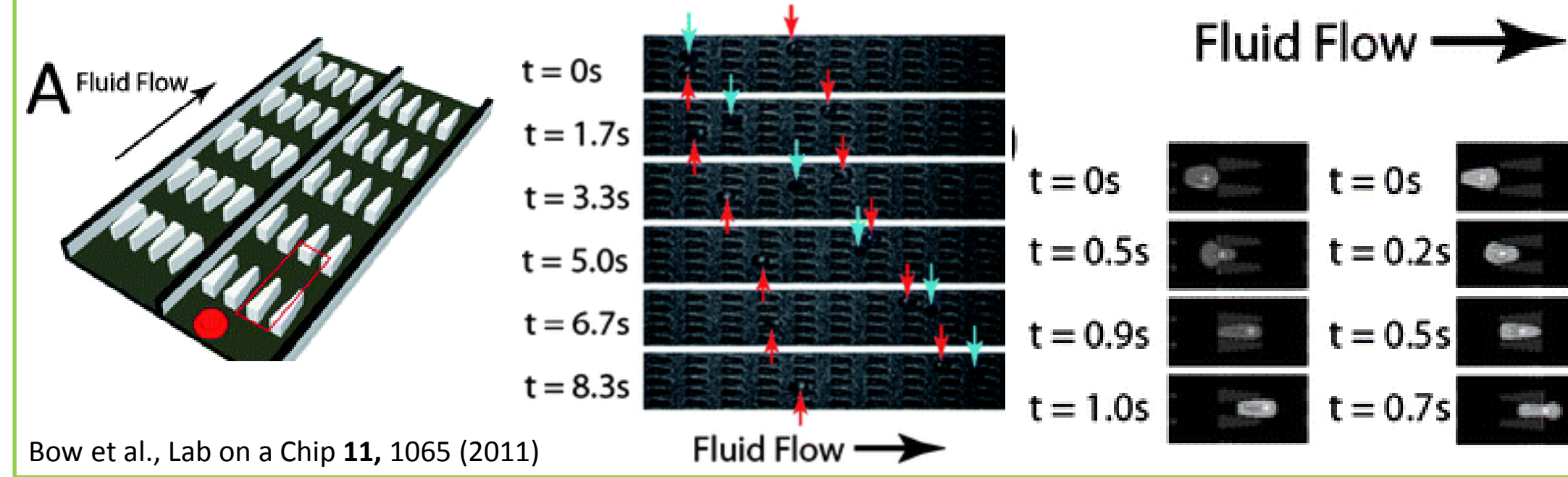


### Motivation

Capsules occur in various applications

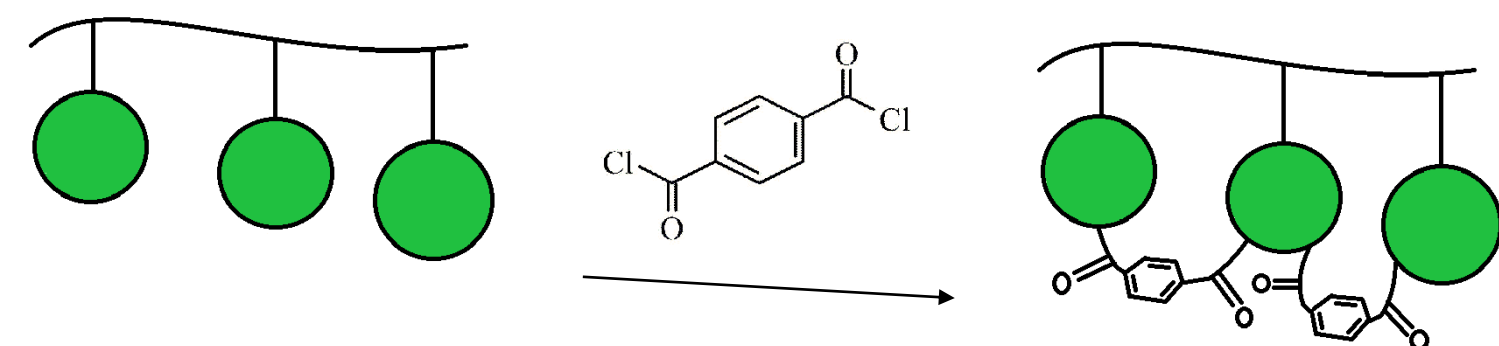
- Food
- Carbonless Paper
- Cosmetics
- Textiles
- Pharmaceuticals
- Living cells

Deformability of diseased cells as a diagnostic tool



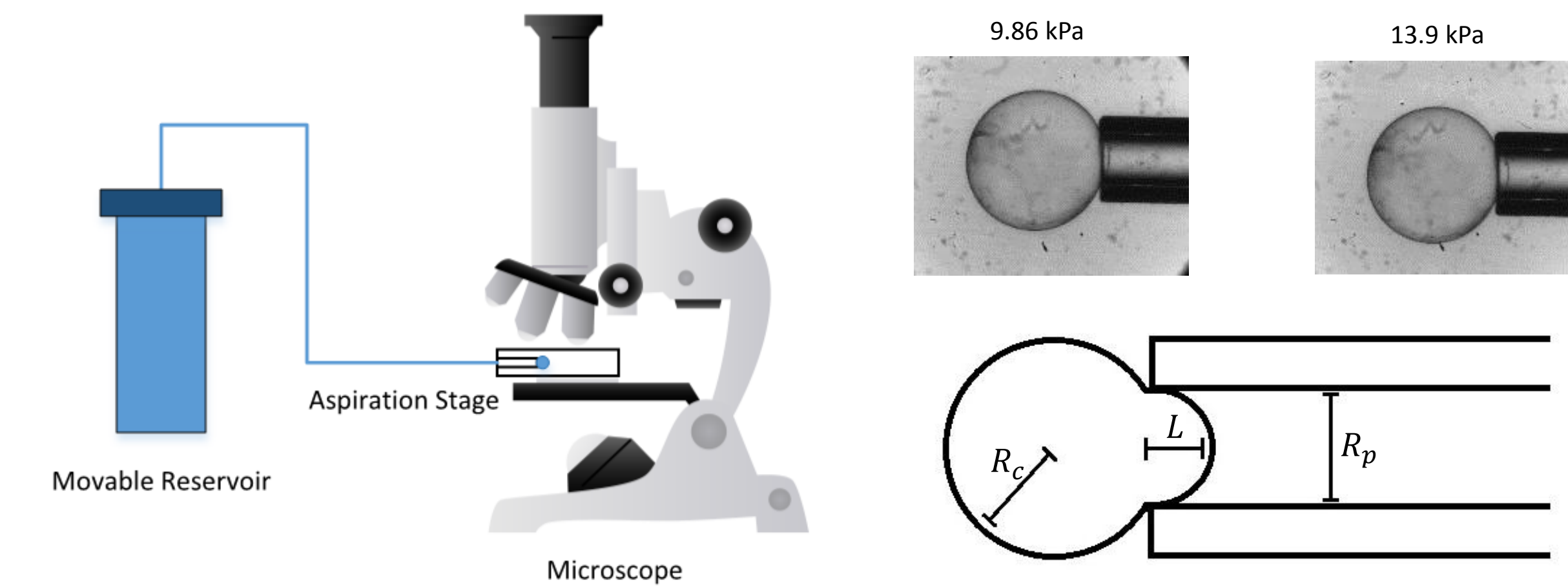
### Goals of Research

• Fabricate robust capsules made from Human Serum Albumin (HSA)

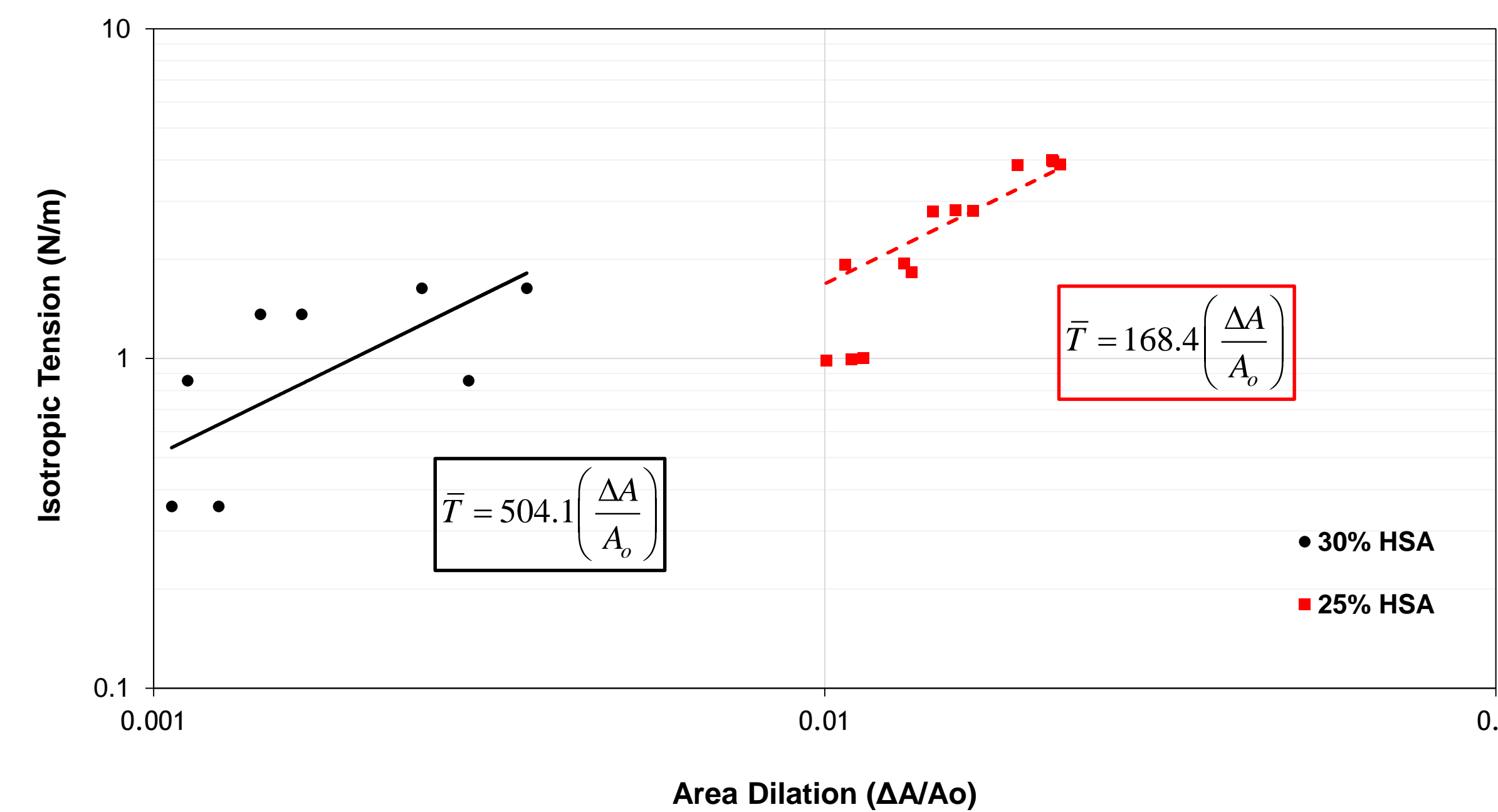


- Measure area compressibility modulus for HSA capsules
- Compare deformation of capsules translating through a sudden contraction with numerical simulations

### Aspiration Experiments

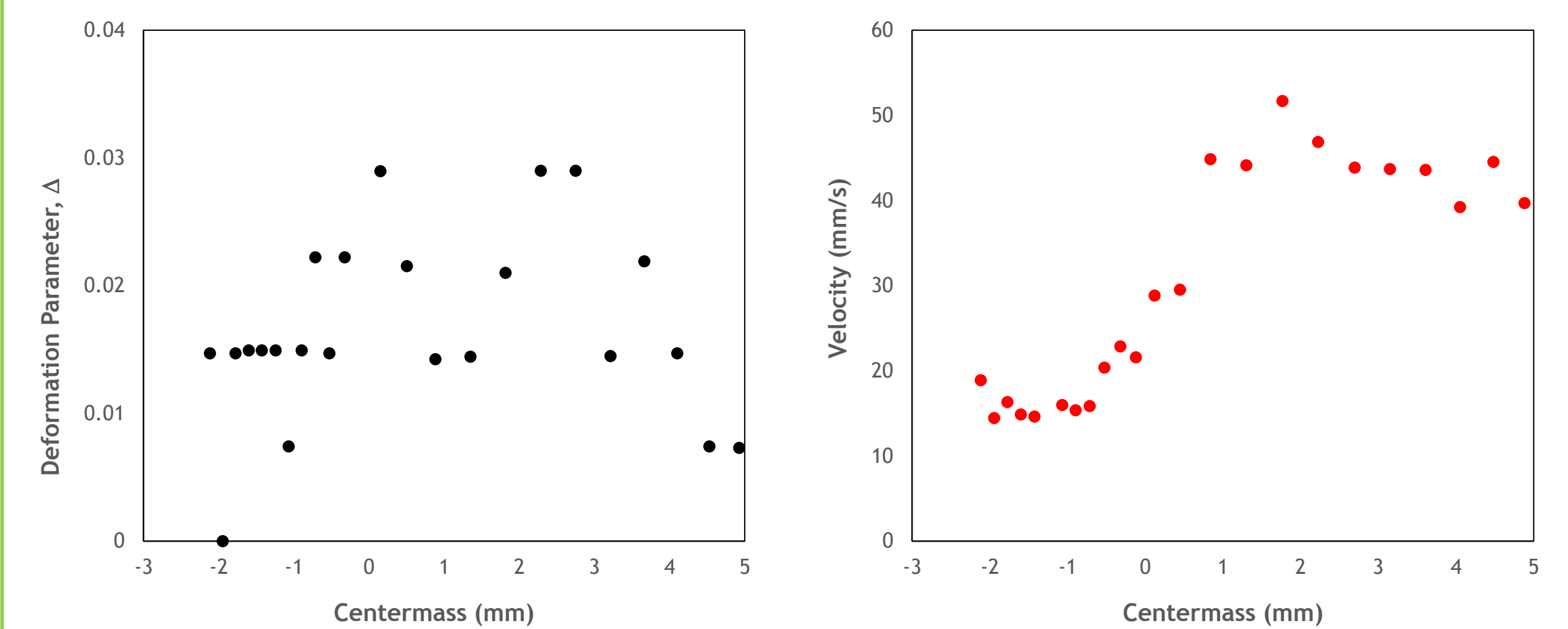
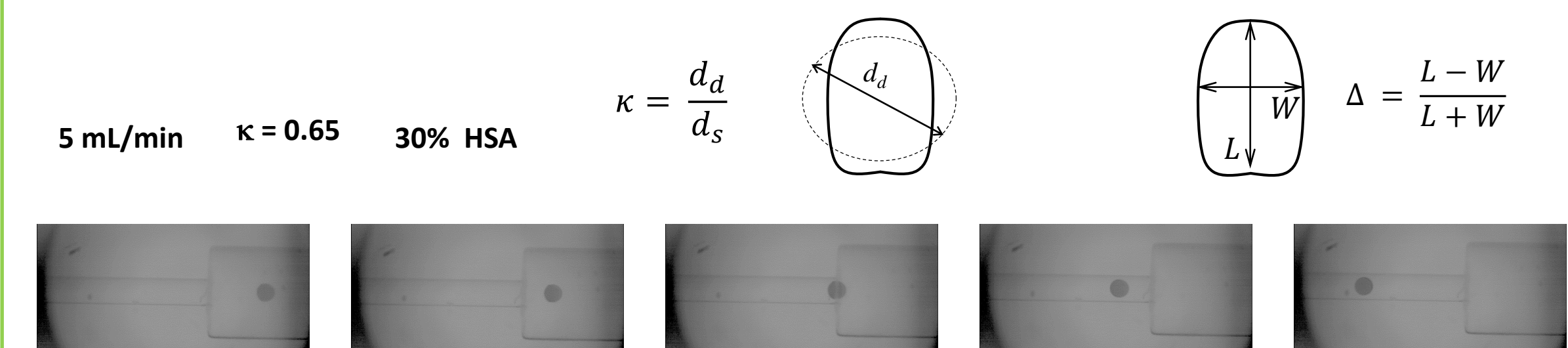
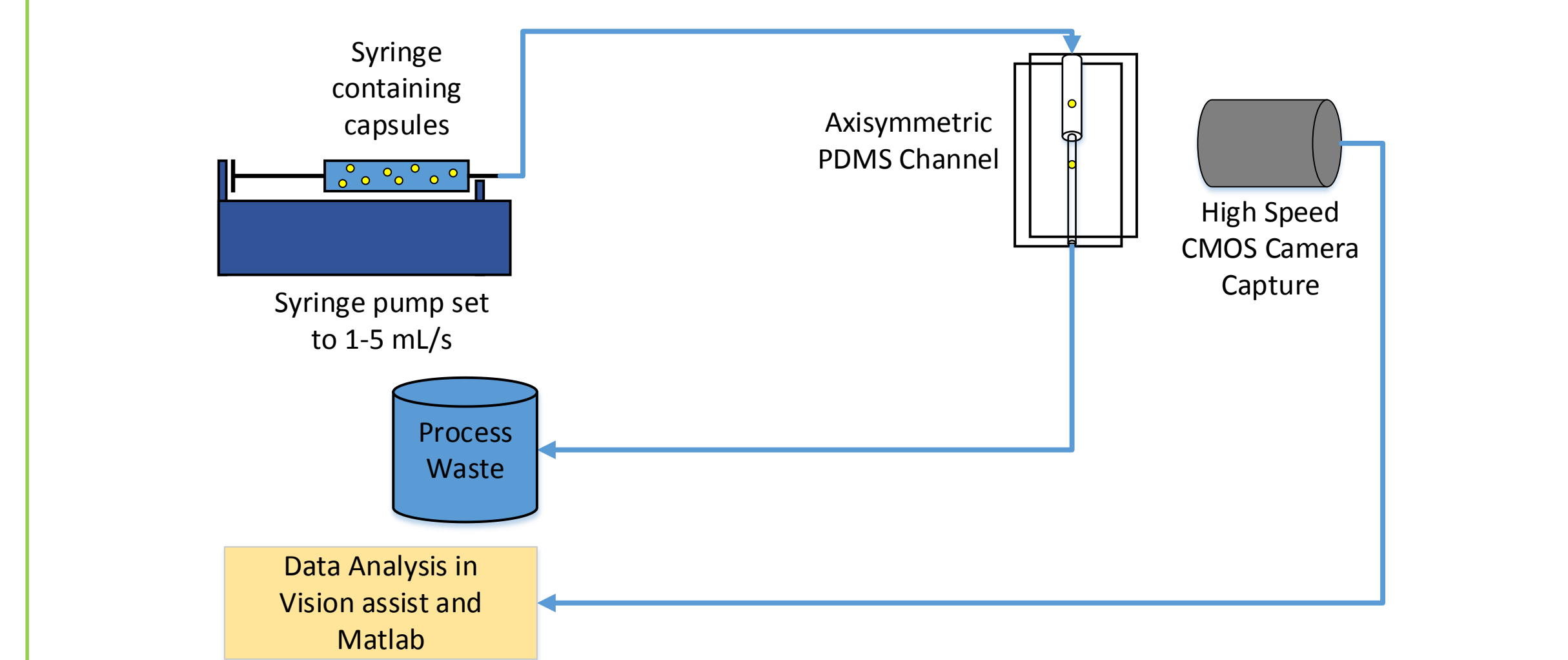


$$\Delta P = 2\bar{T} \left( \frac{1}{R_c} - \frac{1}{R_p} \right) \quad \Delta A = 2\pi [R_p \cdot \Delta L \left( 1 - \frac{R_p}{R_c} \right)] \quad \bar{T} = K \cdot \Delta A / A_0$$



Compressibility modulus for 30% HSA capsules larger than for 25% HSA capsule

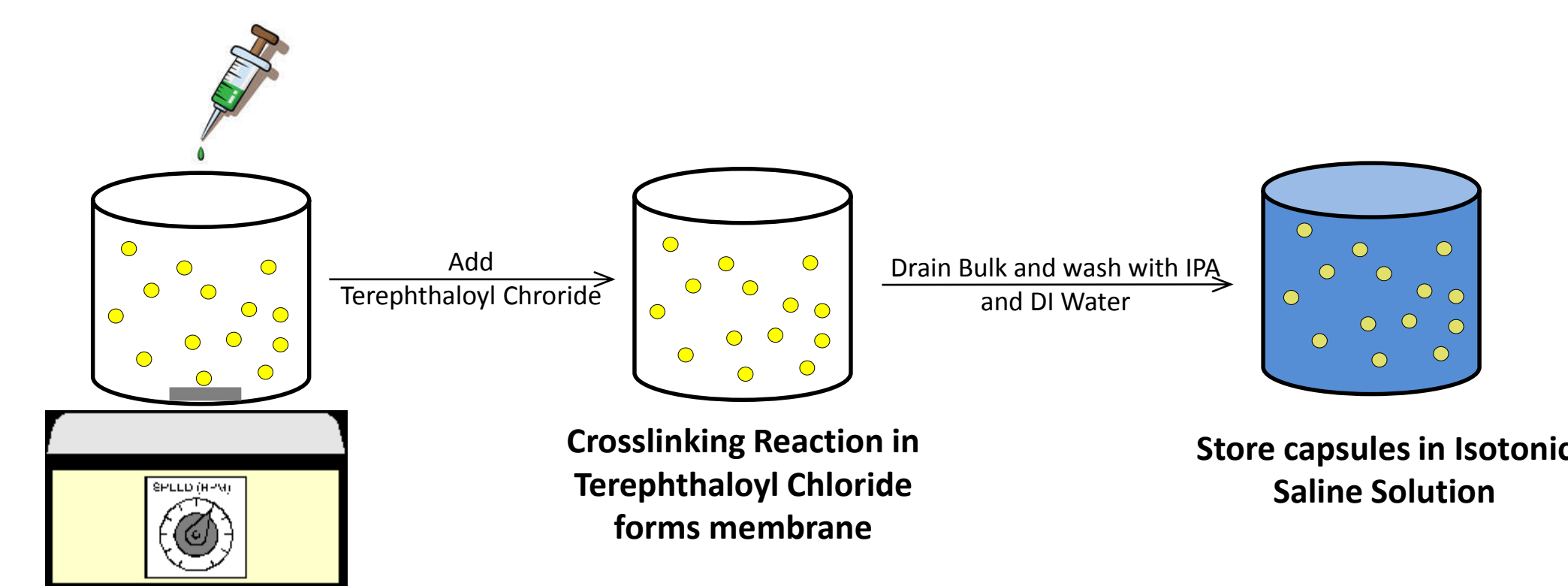
### Capsule Deformation Studies



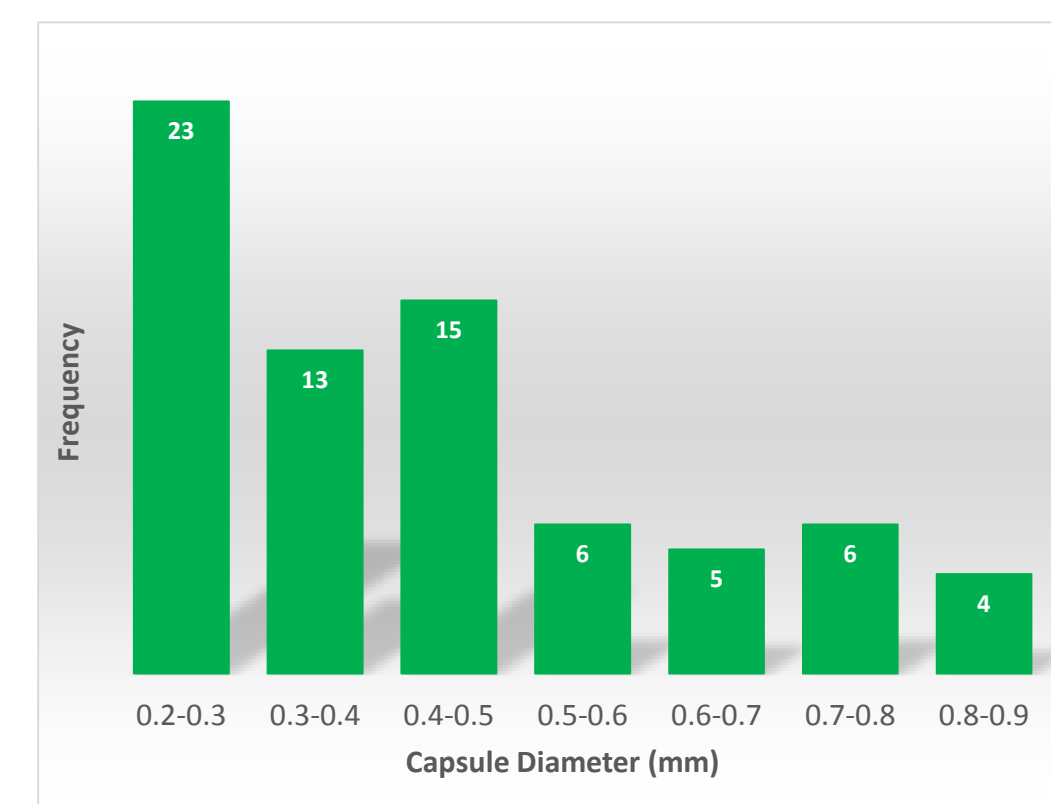
30% HSA capsule shows negligible deformation

### Fabrication and Optimization of HSA Capsules

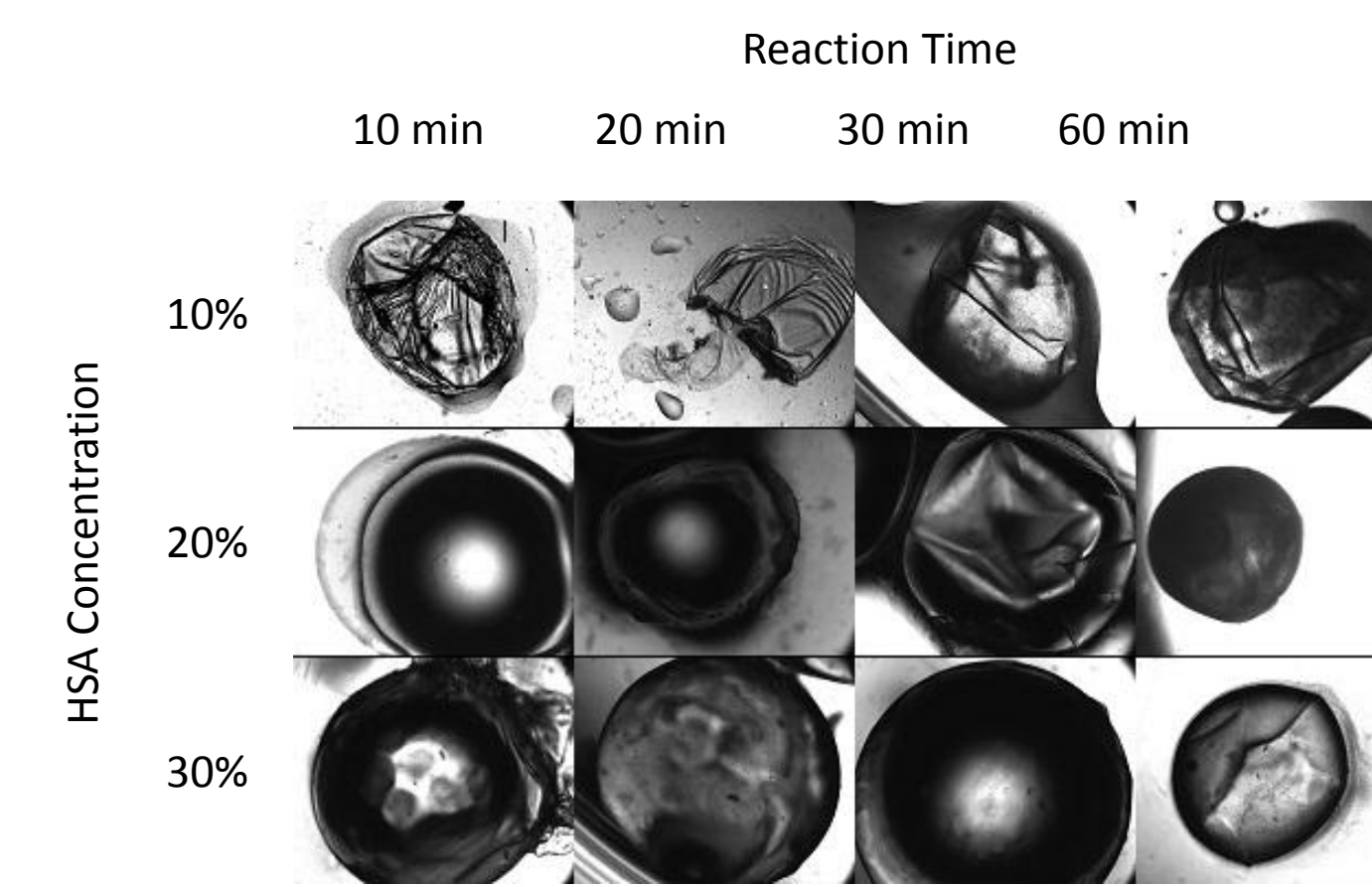
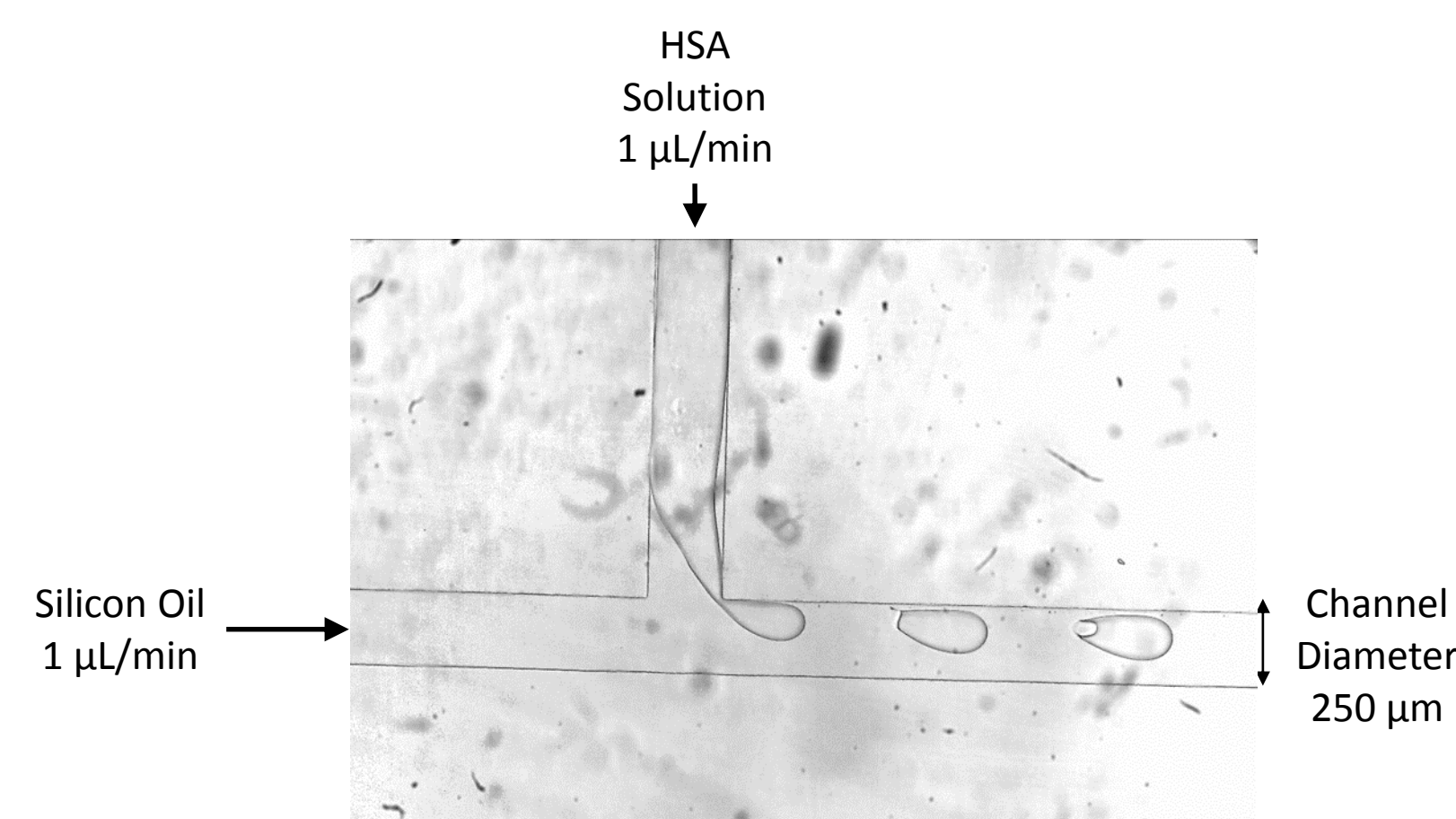
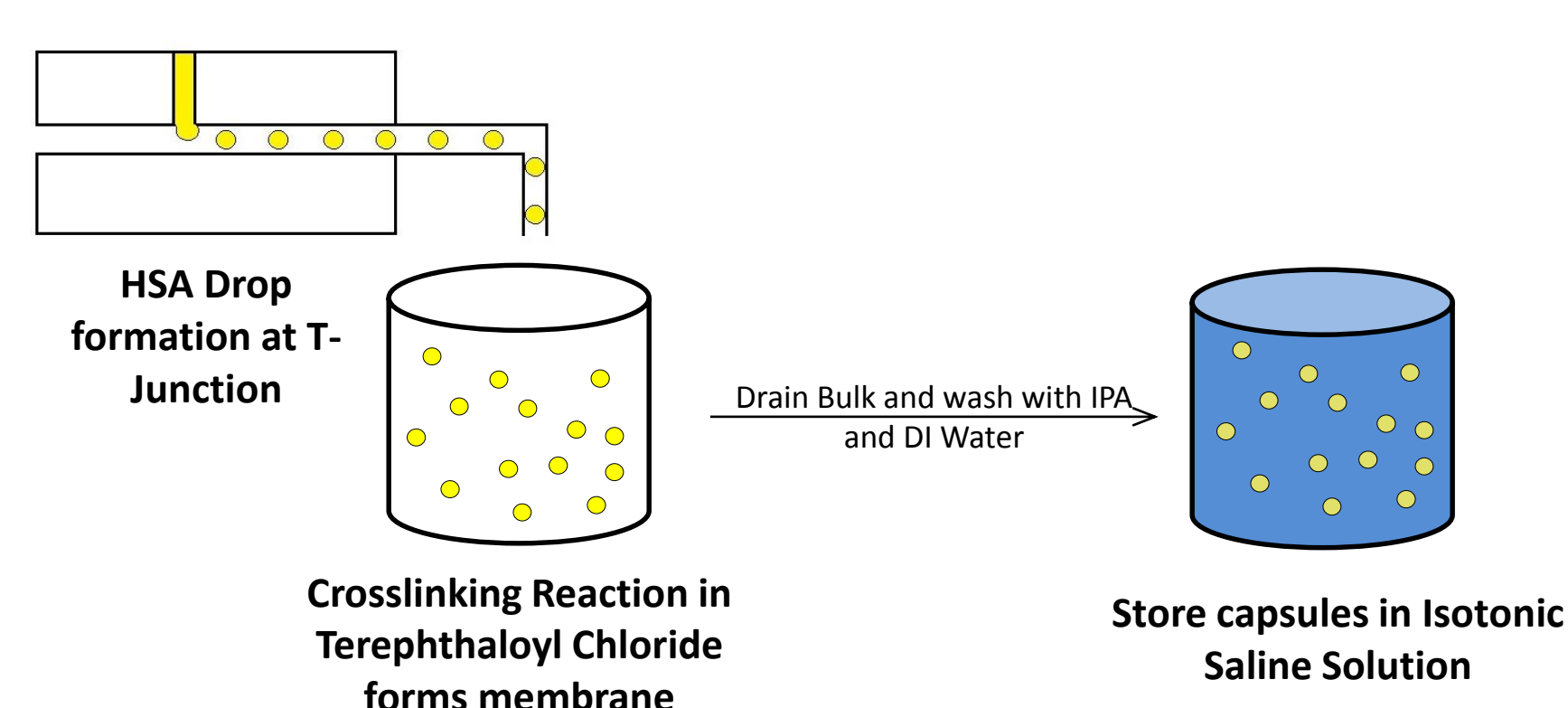
#### Emulsion Method



Polydisperse distribution of capsules using emulsion method  
Average diameter ~ 0.4 mm



#### T-junction Method



Robust capsules with 20 minute reaction time and 20 - 30% HSA

Constant drop size and uniform membrane thickness with T-junction method

T-junction can be scaled from 50 μm to 1 mm in size

Droplets not spherical due to non-Newtonian HSA solution

### Summary

- Robust capsules for 20% - 30% HSA solution with 20 minute reaction time
- Compressibility modulus for 25% HSA capsules was 168 N/m and 30% HSA capsules was 504 N/m
- Preliminary experiments set up for drop deformation through a sudden contraction

### Future Work

- Compare capsule behavior to numerical simulations
- Experiment with other Proteins or polymers
  - Bovine serum albumin
  - Alginate

### Acknowledgements

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