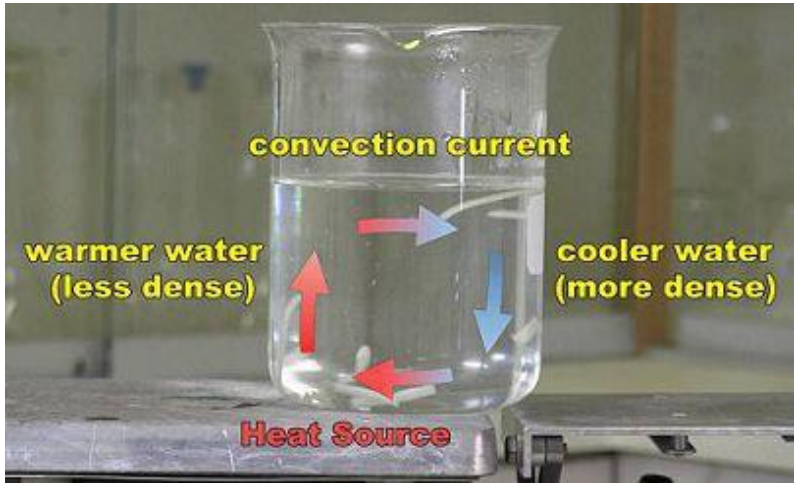
# Crystallization of High-Quality Proteins using Microfluidic Devices

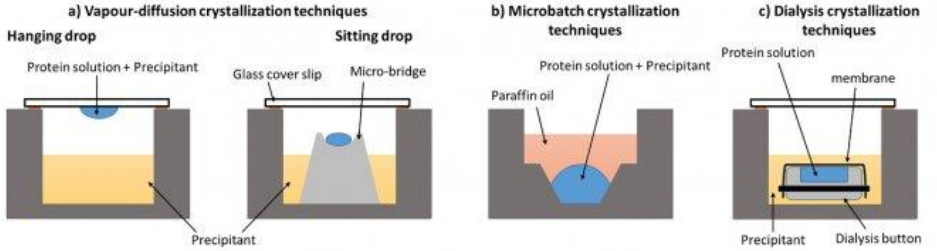
Ilya Avros, Hansen Pan, Jack Yakoub, Mohammed Bah, Jonathan Fey, Charles Maldarelli, Jing Fan

The City College of New York

# Introduction

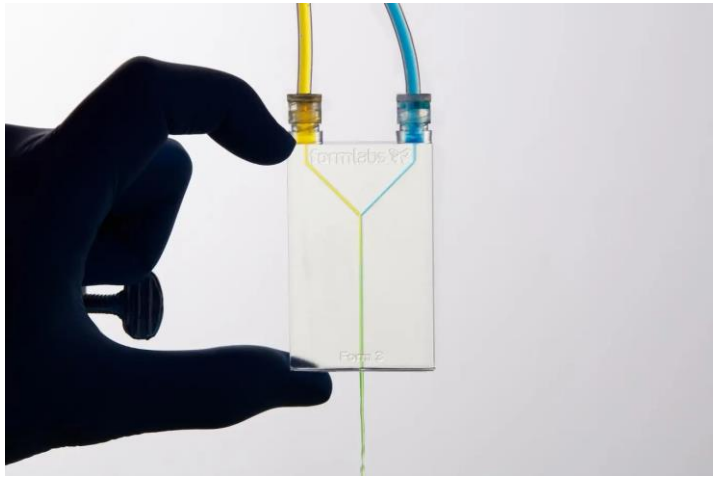
- Increased interest by the pharmaceutical industry for reproducible methods for growing large, high-purity protein crystals.
- Current batch based methods of growing protein crystals are inefficient.
    - Influence of convection.
    - Expensive Materials.
    - Relatively low yield of ideal crystals for therapeutic applications.

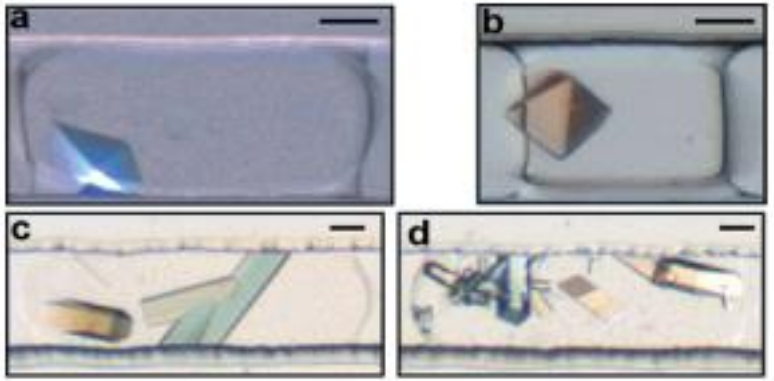


# Microfluidic Approach

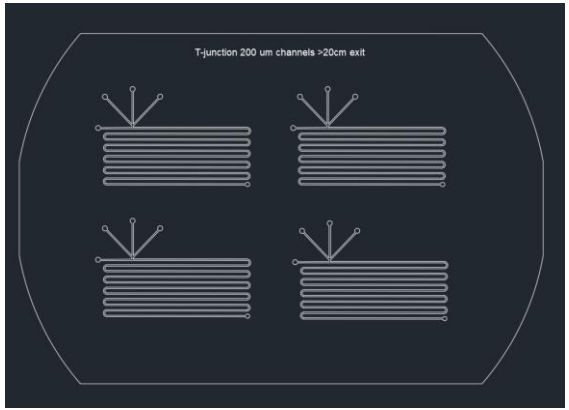
- Microfluidic approach allows for a higher degree of control.
    - Microgravity environment.
    - Minimized Reynolds number.
    - Concentration gradient.
    - Less material wastage.

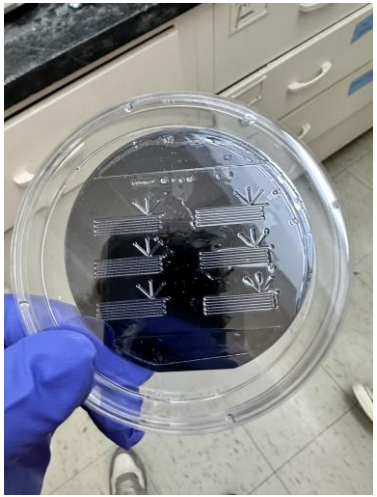


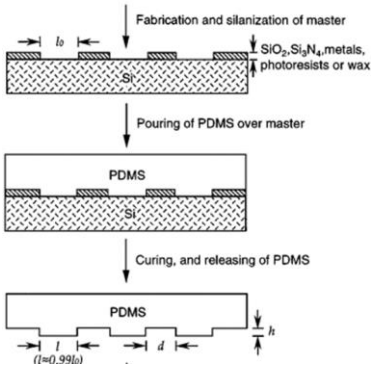


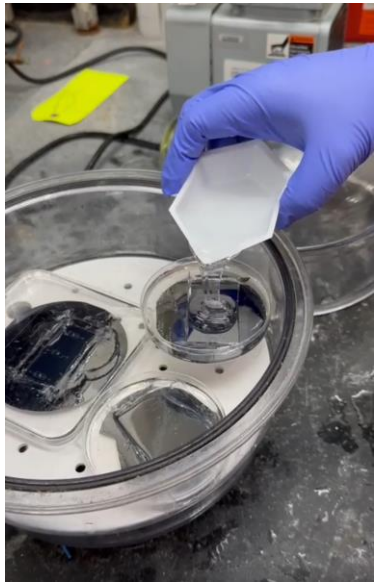
# Materials/Manufacturing

- AutoCAD drawings.
- Soft Lithography with minor modifications.
  - Outsourced production of UV masks.
  - Lamination using 200 micron photoresist films.
- PDMS based devices.
  - Plasma binding to glass slides
- Channels treated with Aquapell.



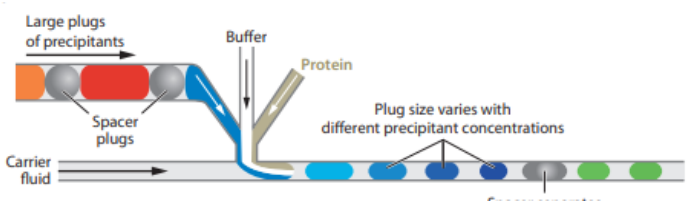



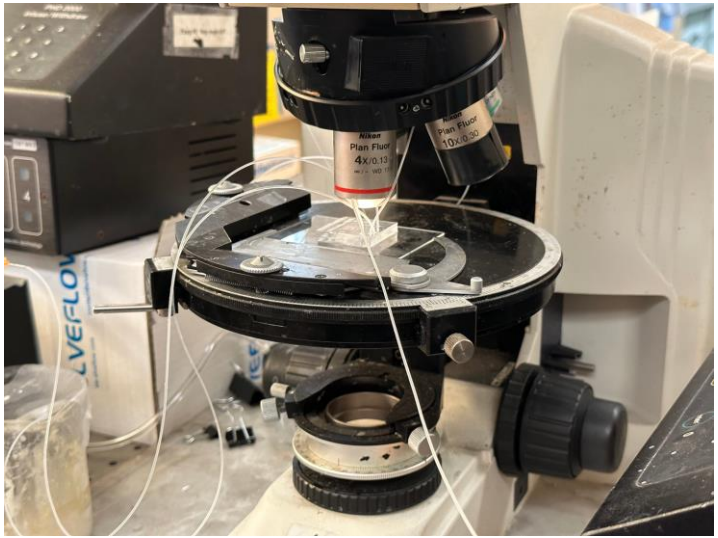


# Experimental Testing

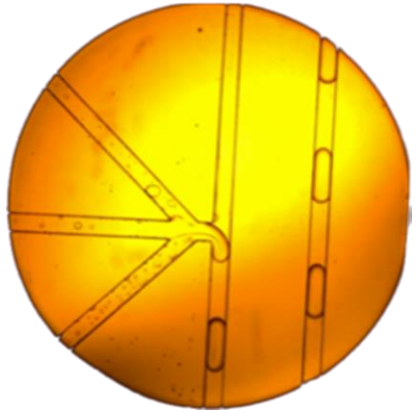
- Dispersed Phase:
  - Hen Egg-White Lysozyme dissolved in deionized water: 105 mg/ml.
  - NaCl: 1.5M dissolved in deionized water.
  - Titration of 3M Sodium Acetate Trihydrate with 99% acetic acid: pH 4.5.
- Continuous Phase:
  - Hydrofluoroether (HFE) oil with 2% w/w fluorosurfactant.

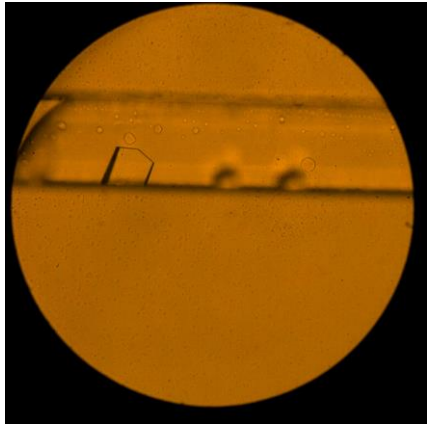


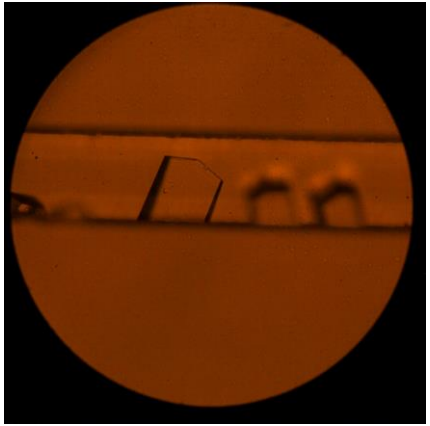



# Results

- Dispersed phase flow rate:
  - 500 µL/hr.
  - Total: 1500 µL/hr.
- Continuous phase flow rate:
  - 2500 µL/hr.
- Monodispersed generation of droplets.
- Crystallization observed over 6-day period.
  - Nucleation approximately 24 hours after droplet generation.
  - Further crystal growth observed 5 days later.

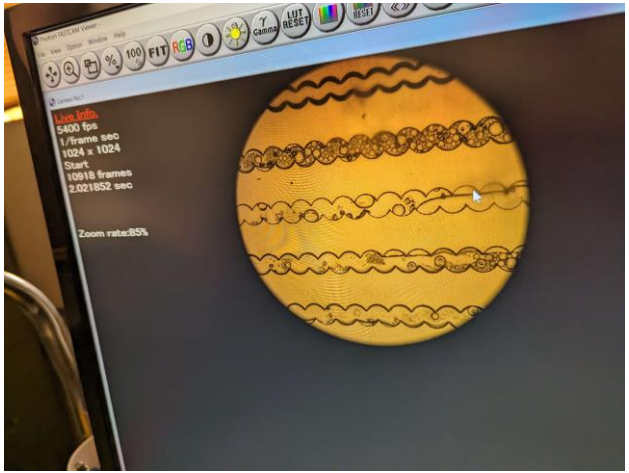






# Future Directions

- Improved sealing of stored droplets.
    - Evaporation of continuous phase.
    - Coalessence of aqueous droplets.
- Backflow into inlet channels.
- Collection of data.
    - Impractical methodology for monitoring several devices.

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