Fabrication and Flow Characterization of Microfluidic Devices

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Detection of illicit drugs
Detection of Methamphetamine Using Microfluidics

What is Microfluidics?

• Manipulation of small amounts of fluids which:
  o Controls flow and mixing
  o Uses small amounts of reactants
  o Enables controllable reactions to occur

Project Goals

• Fabricate a microfluidic device
  o Use UV-Curable polymers (NOA81)*
• Operate device using constant pressure flow
• Characterize flow with visualization techniques
  o micro- Particle Image Velocimetry (μPIV)
  o fluorescent dye
  o high speed camera

Schematic of our Microfluidic Device

Exploded View

Sandwiched View

Glass Slides

Cured polymer

Cured polymer
Fabrication of the Microfluidic Device

PDMS mold

UV Light

Slide with Device Layer

Flat Mold

UV Light

Completed Device

Operating the Device

Four distinct inlets

Outlet

$\Delta P =$ Pressure difference between inlets and outlet.
Micro Particle Image Velocimetry (µPIV)

\[ \Delta t = 500 \, \mu s \]

\[ v = 24 \, \text{cm/s} \quad \Delta P = 1 \, \text{Atm} \]
Visualizing diffusion with fluorescent dye

$\Delta P = 1 \text{ Atm}$

$\Delta P = 0.4 \text{ Atm}$
Visualizing droplet flow with high-speed Camera

$\Delta P_{\text{Oil}} = 1.9 \text{ Atm}$

$\Delta P_{\text{water}} = 1.3 \text{ Atm}$

5,045 FPS

560 droplets/second

$\Delta P_{\text{Oil}} = 1.6 \text{ Atm}$

$\Delta P_{\text{water}} = 1.3 \text{ Atm}$

3,400 droplets/second

5,045 FPS
Conclusion

• We created a microfluidic device, using UV-Curable polymers
  o Operated the device using constant pressure flow
• Characterized flow using various visualization techniques
• Moving forward we hope to use Microfluidic to detect narcotics
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\[ x = \sqrt{2D t} \quad D = \frac{k_B T}{6\pi r \eta} \]