## FABRICATION AND CHARACTERIZATION OF A FLUID MICROMIXER

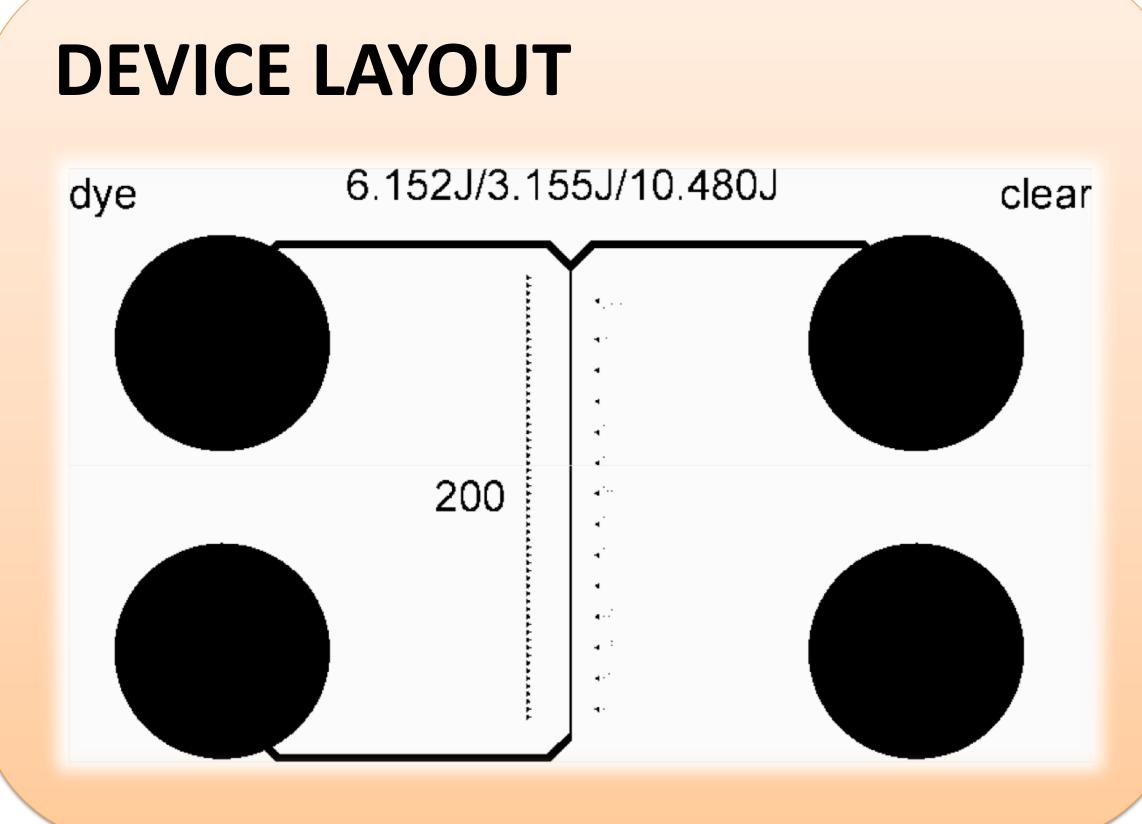
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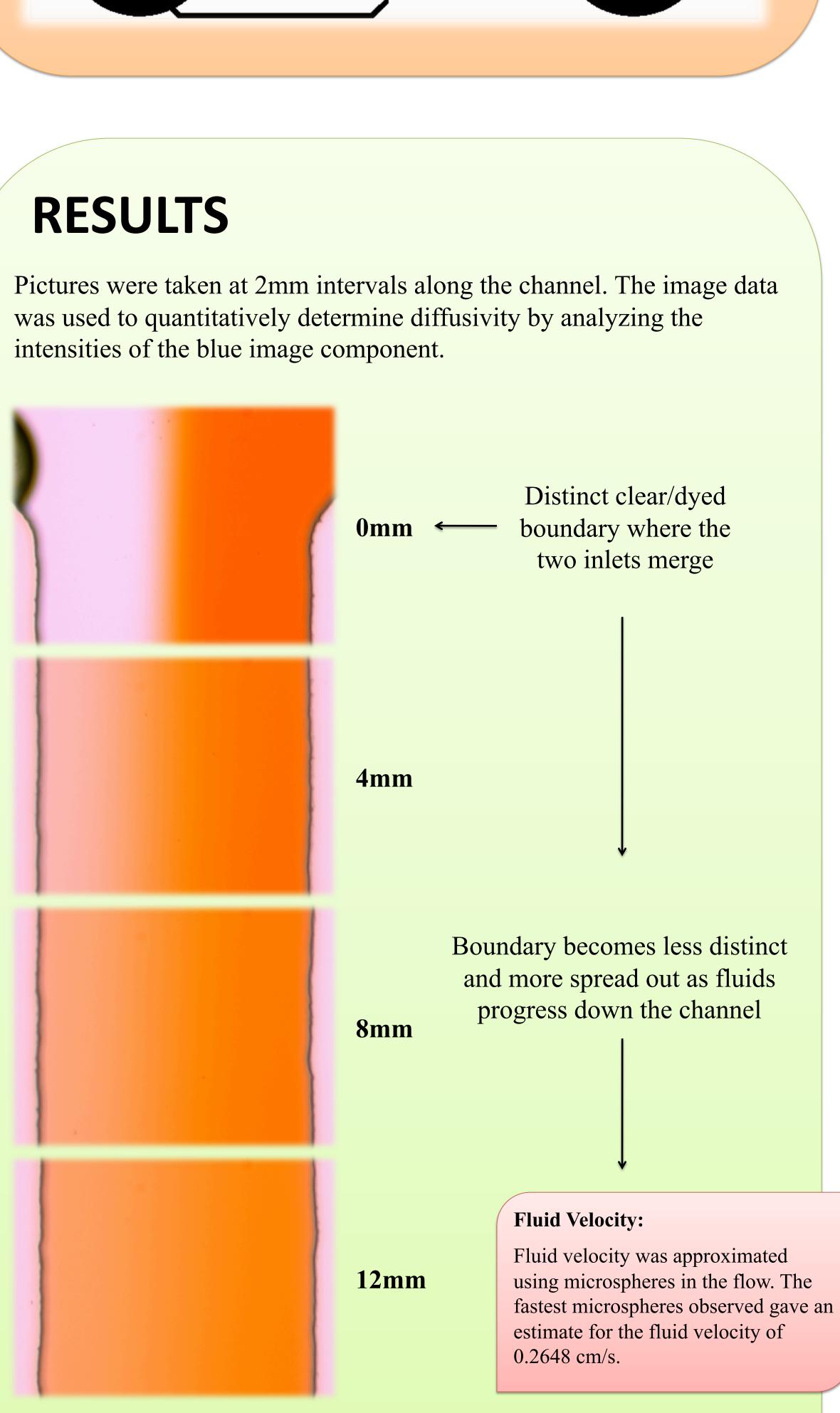
## 6.152 - Massachusetts Institute of Technology

#### **OBJECTIVES**

- To fabricate a microfluidic channel in PDMS (a polymer) with two inlets and one outlet
- To experimentally determine the diffusivity of red dye in water by mixing red-colored water and colorless water as they flow through the channel

## **FABRICATON** Spin on SU-8 to approximately 40 μm **SU-8:** A photo-definable, epoxy-based, negative resist. It allows high aspectratio features (up to 25:1). Photolithography Develop "Master" Mold PDMS Pour PDMS on mold PDMS: Poly-Di-Methyl Siloxane A polymer; well-suited for microfluidics because of stability, biocompatability, and ease of fabrication. PDMS Remove PDMS after curing tubing Press PDMS against glass plate after plasma ashing both pieces to bond, Insert plastic tubing





## **ANALYSIS** Blue Intensity versus Cross-channel Pixel Position Blue Intensity Gradient versus Cross-channel Pixel Position Cross-channel Position (pixels) (a) – Intensity for 0mm image (b) – Intensity gradient for 0mm image 1) Blue intensity in the horizontal dimension was averaged 3) The artifacts from the channel edges were eliminated by over all vertical lines in the image, and a moving constraining the further analysis to the "region of average of size 10 was used to smooth the curve interest" that only contained data from within the (example graph (a) above). channel. 2) The gradient of the intensity curve was produced 4) The region of interest was normalized, and the characteristic width (w) is the width where the intensity (example graph (b) above). gradient is greater than half its peak value. Squared Characteristic Distance versus Time for Red Dye Diffusion Individual Images Linear Fit (cm) 1.5 (c) – Combining characteristic width data from all images **Experimental Diffusivity:** $D = w^2 / (4 \ln(2) t)$ $1.517 * 10^{-6} \text{ cm}^2/\text{s}$ slope of the linear fit in graph (c) = $(4 \ln(2) D)$ **Theoretical Diffusivity:** $D = \text{slope} / (4 \ln(2))$ $2 * 10^{-6} \text{ cm}^2/\text{s}$

# Conclusion

Cross-channel Position (pixels)

• Experimental diffusivity is close to the theoretical diffusivity (experimental is 75.86% of theoretical).

Artifact from

- Time t is inversely related to the flow velocity, and t is inversely related to the diffusivity D, so D is directly related to the estimated flow velocity.
- Flow velocity is estimated by observing microspheres in the liquid, which may not be travelling at the full speed of the liquid, accounting for the slightly low experimental diffusivity.
- Overall, the liquid flowed and mixed cleanly, and the diffusivity was close to the expected value.
- Fabrication and characterization were both successful.