

FABRICATION AND CHARACTERIZATION OF A FLUID MICROMIXER

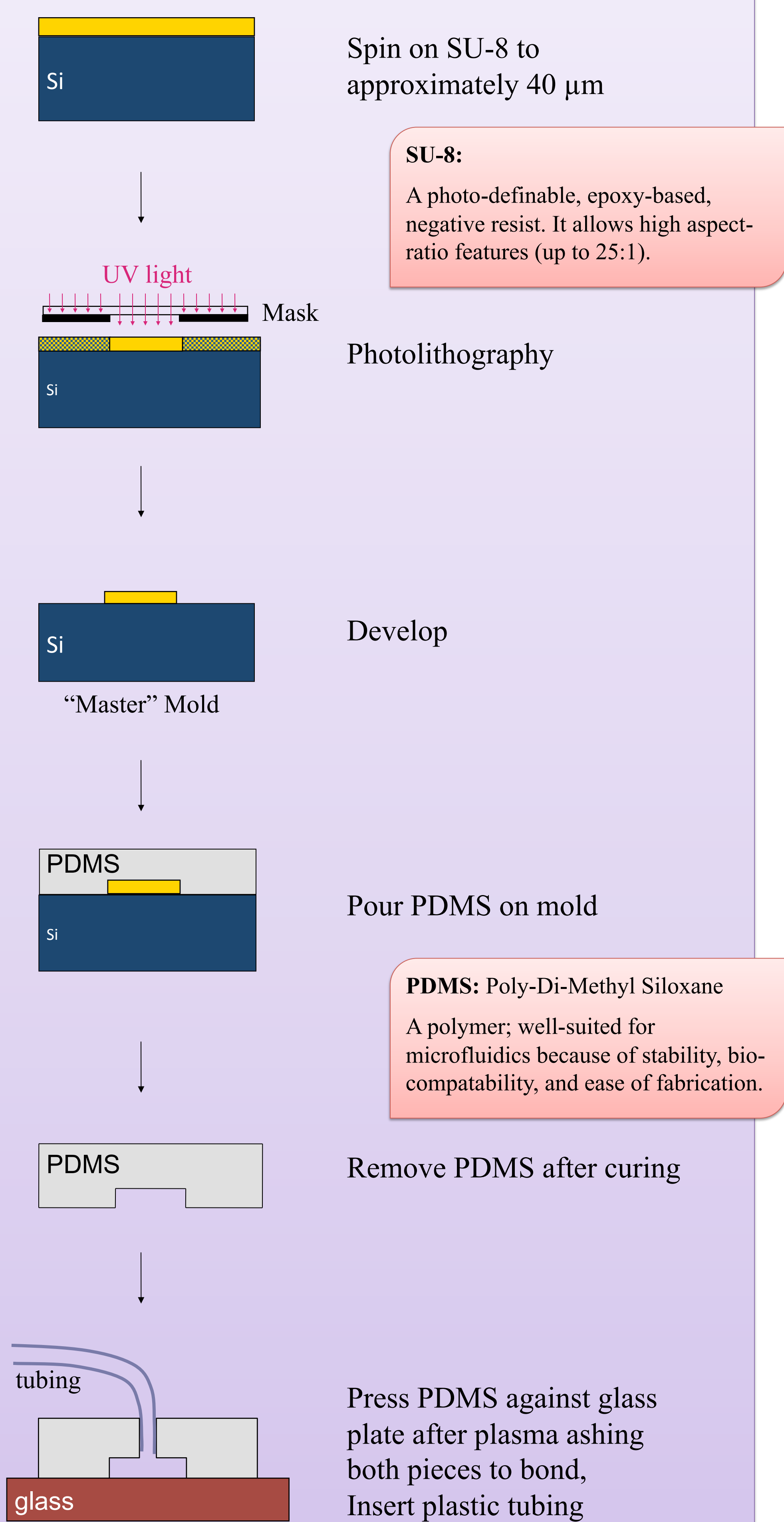
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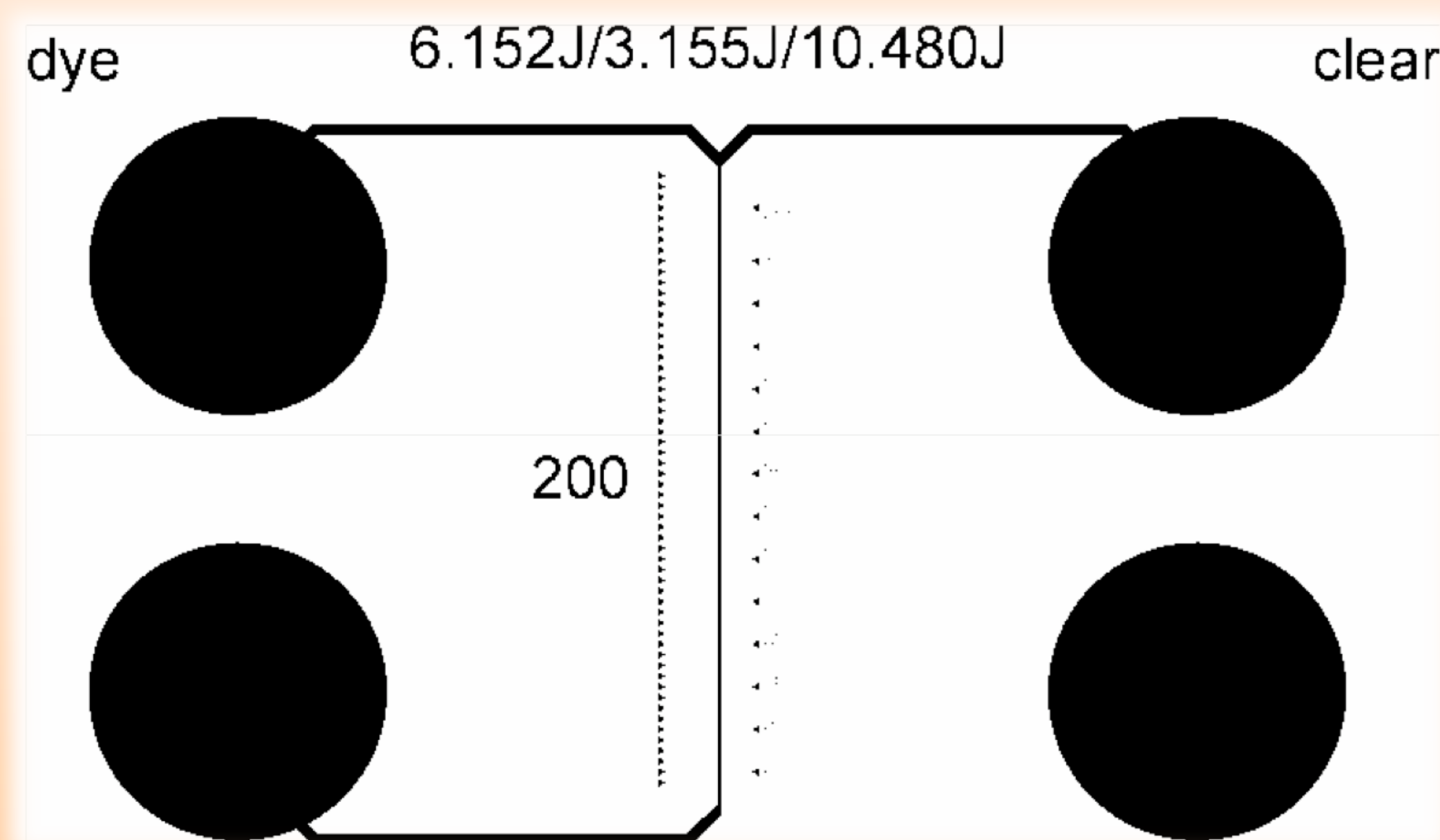
OBJECTIVES

- ◆ 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

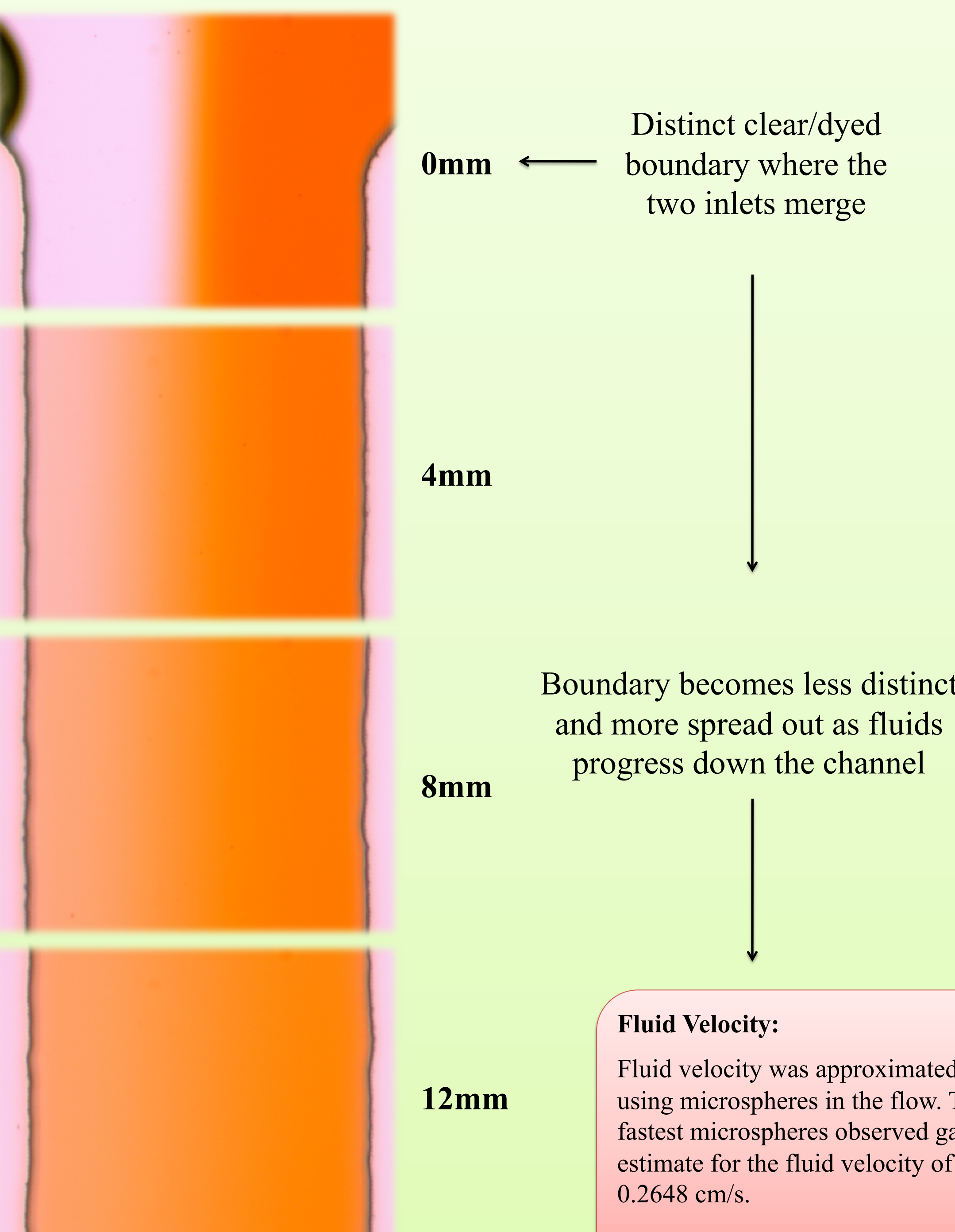


DEVICE LAYOUT

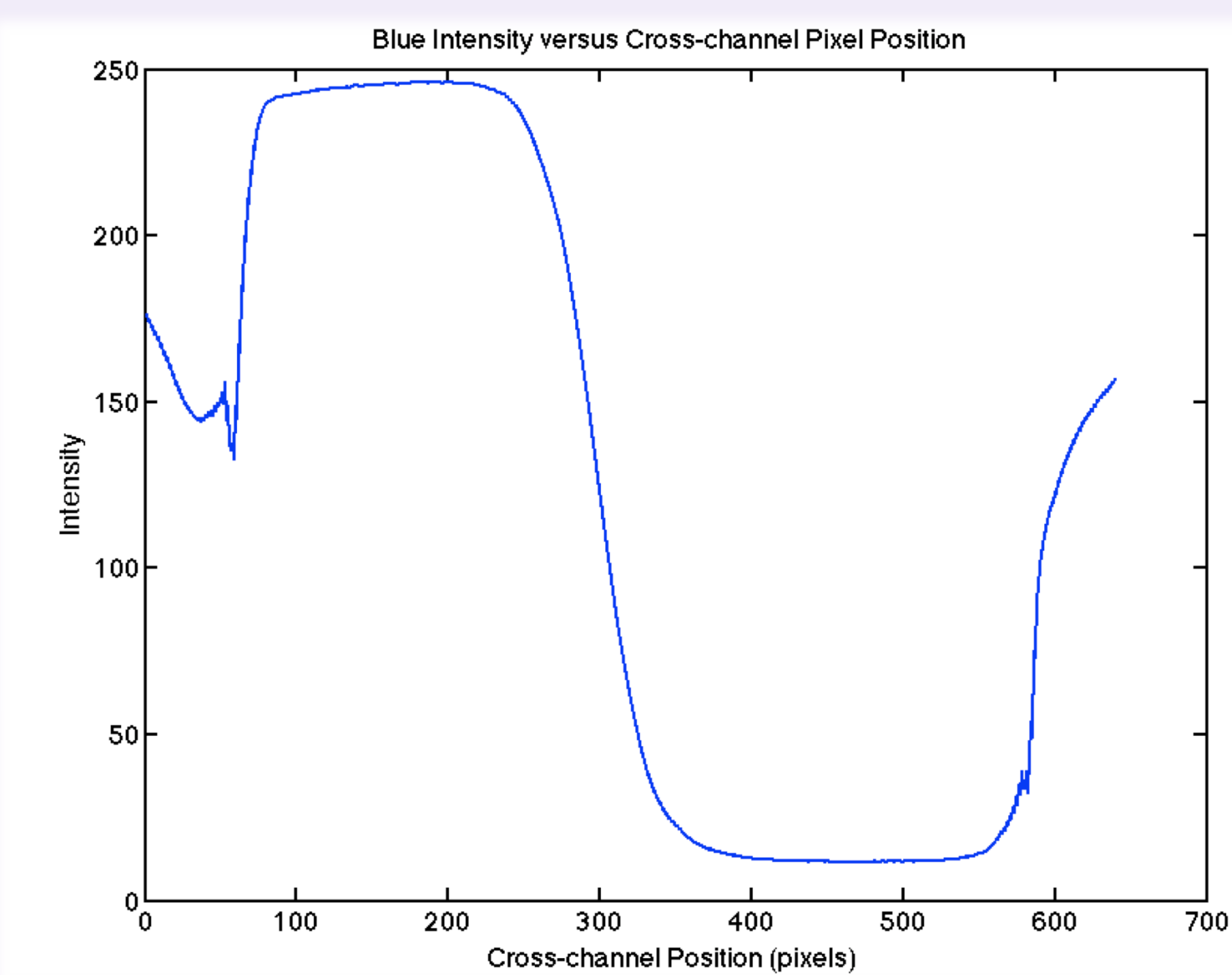


RESULTS

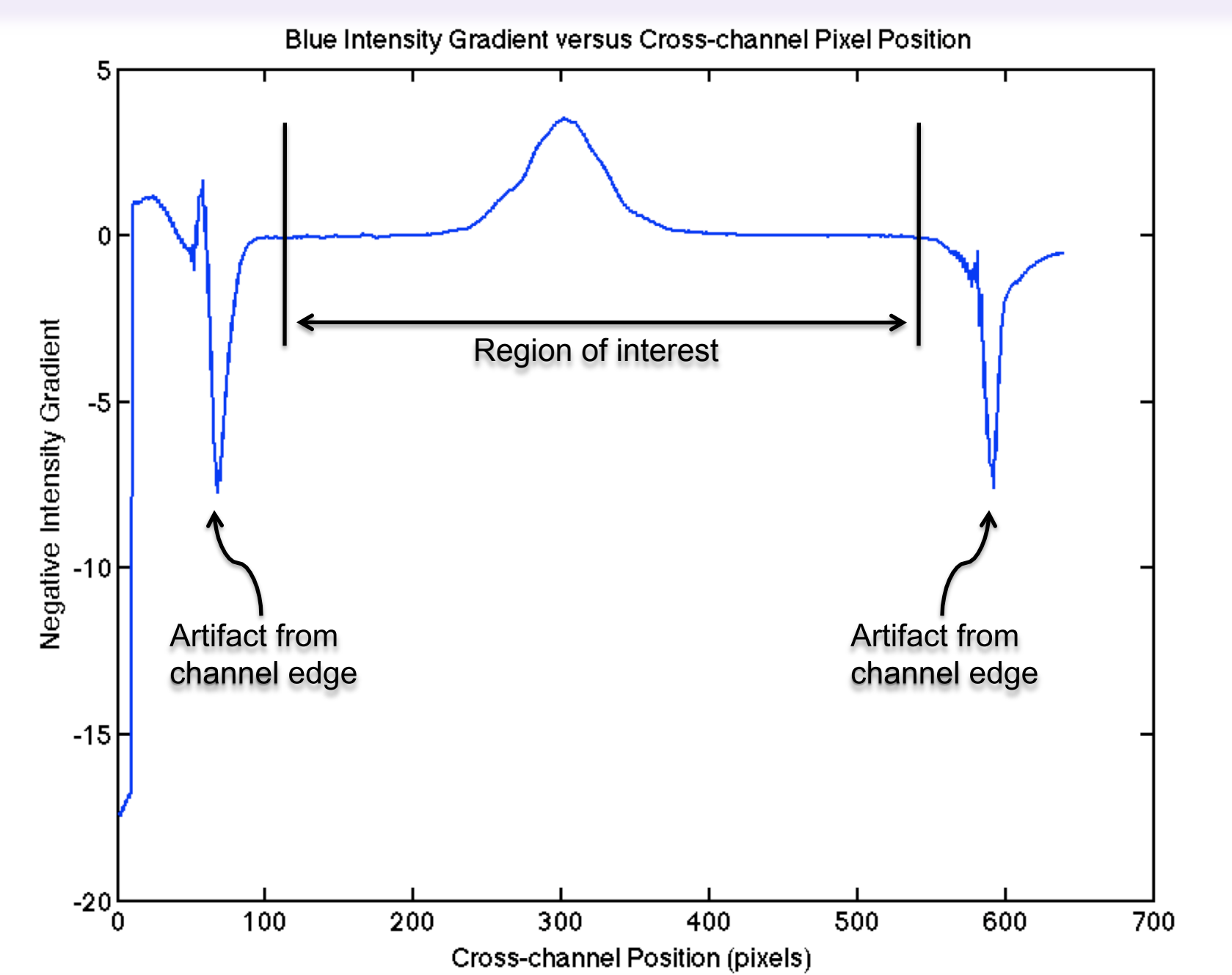
Pictures were taken at 2mm intervals along the channel. The image data was used to quantitatively determine diffusivity by analyzing the intensities of the blue image component.



ANALYSIS

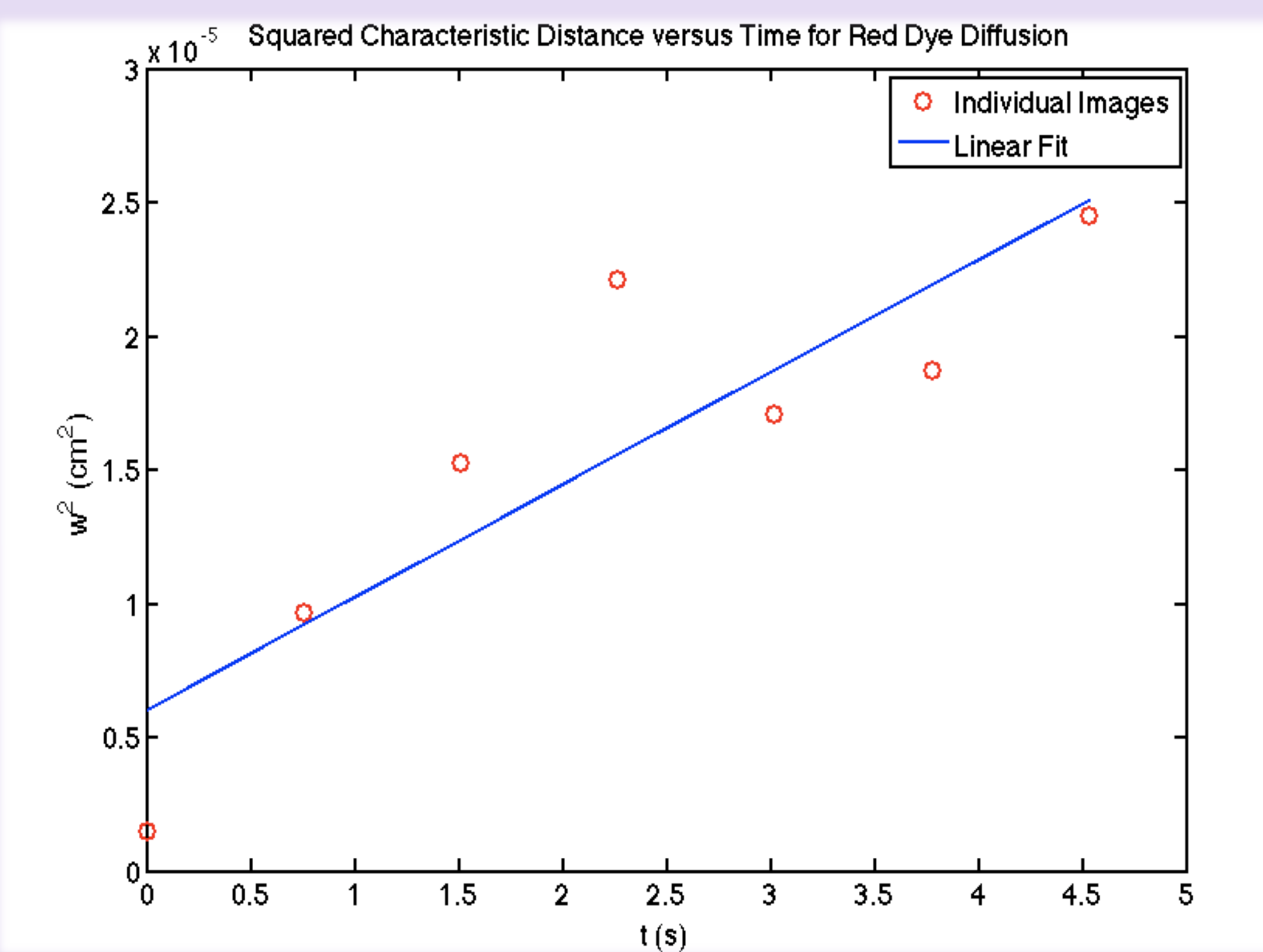


(a) – Intensity for 0mm image



(b) – Intensity gradient for 0mm image

- 1) Blue intensity in the horizontal dimension was averaged over all vertical lines in the image, and a moving average of size 10 was used to smooth the curve (example graph (a) above).
- 2) The gradient of the intensity curve was produced (example graph (b) above).
- 3) The artifacts from the channel edges were eliminated by constraining the further analysis to the “region of interest” that only contained data from within the channel.
- 4) The region of interest was normalized, and the characteristic width (w) is the width where the intensity gradient is greater than half its peak value.



(c) – Combining characteristic width data from all images

Experimental Diffusivity:

$$1.517 \times 10^{-6} \text{ cm}^2/\text{s}$$

Theoretical Diffusivity:

$$2 \times 10^{-6} \text{ cm}^2/\text{s}$$

$$D = w^2 / (4 \ln(2) t)$$

$$\text{slope of the linear fit in graph (c)} = (4 \ln(2) D)$$

$$D = \text{slope} / (4 \ln(2))$$

Conclusion

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