

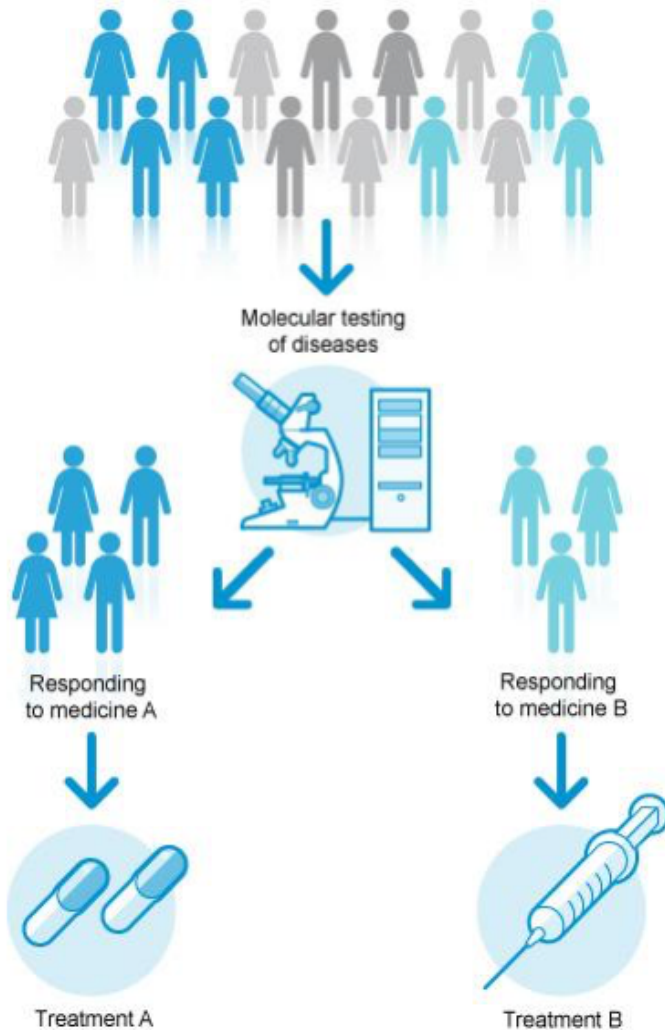
Microfluidic system for label-free chemical/biological detection using nanowire FET sensors

Christy Contreras

Physics Department, Arizona State University

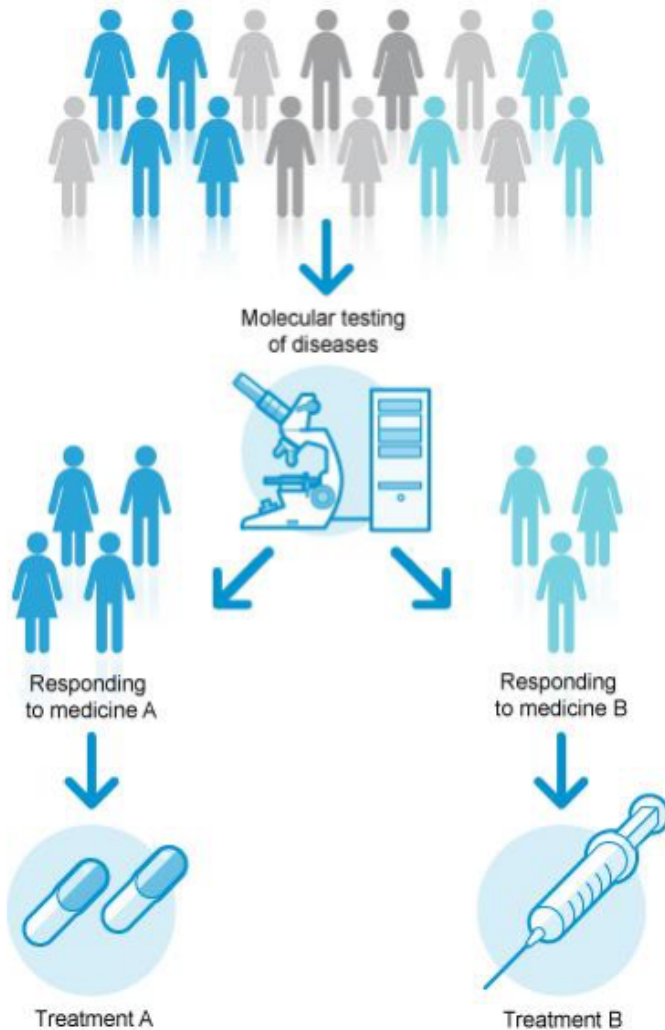
Motivation: Personalized Medicine

Personalized medicine



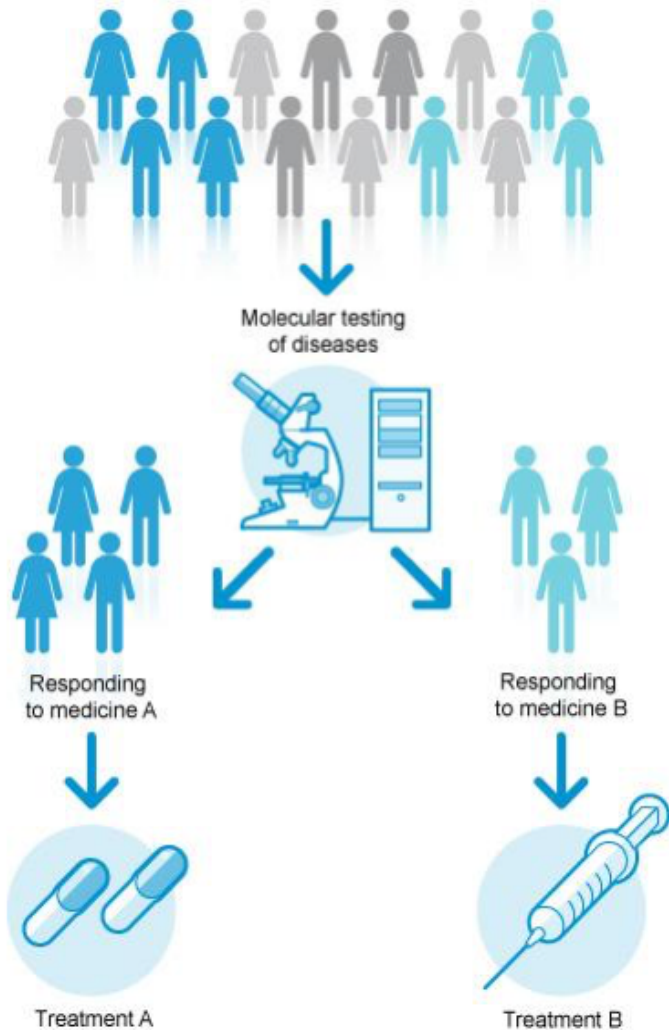
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Proposed Solution: An Integrated System

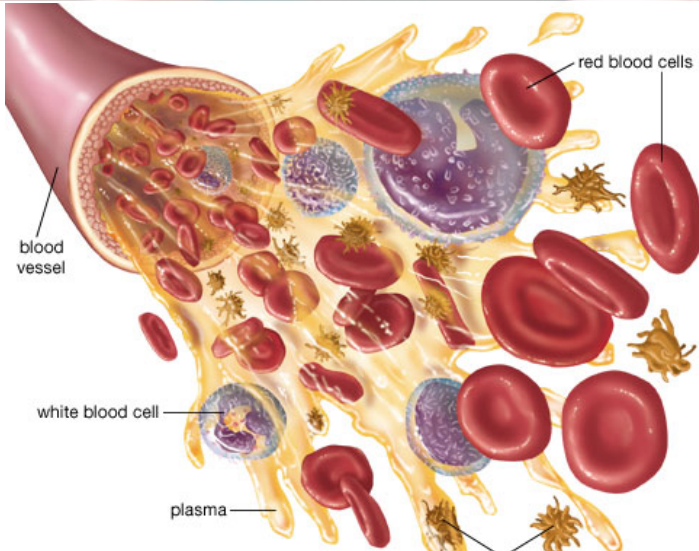


- Innovative and powerful integrated technology

Proposed Solution: An Integrated System



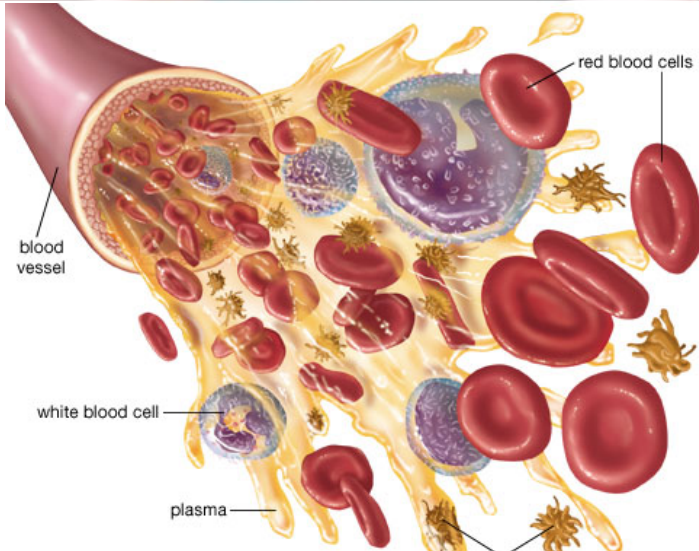
- Innovative and powerful integrated technology
- Able to handle small liquids and detect biomolecules like protein and DNA



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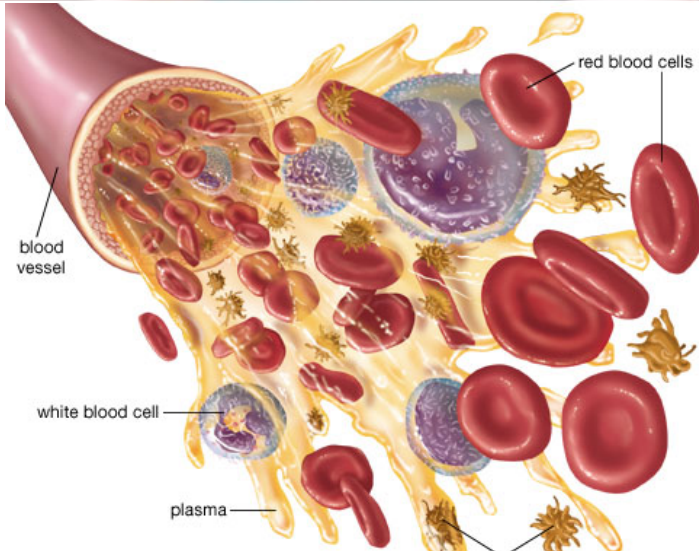
- Innovative and powerful integrated technology
- Able to handle small liquids and detect biomolecules like protein and DNA
- Revolutionary tool for biomedical applications and disease diagnostics



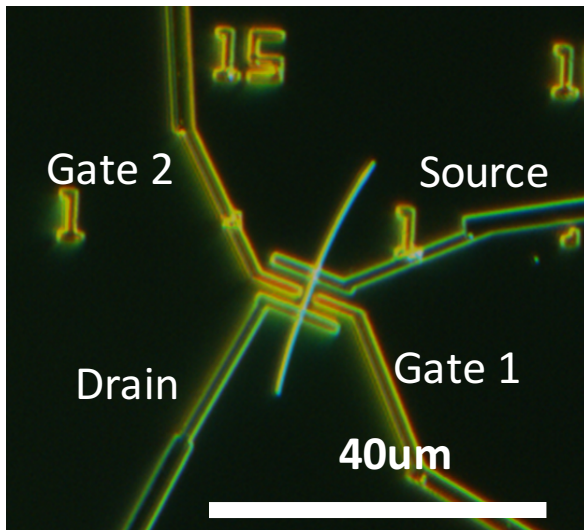
Proposed Solution: An Integrated System



- Innovative and powerful integrated technology
- Able to handle small liquids and detect biomolecules like protein and DNA
- Revolutionary tool for biomedical applications and disease diagnostics
- Two components: an FET biosensor and a microfluidic platform

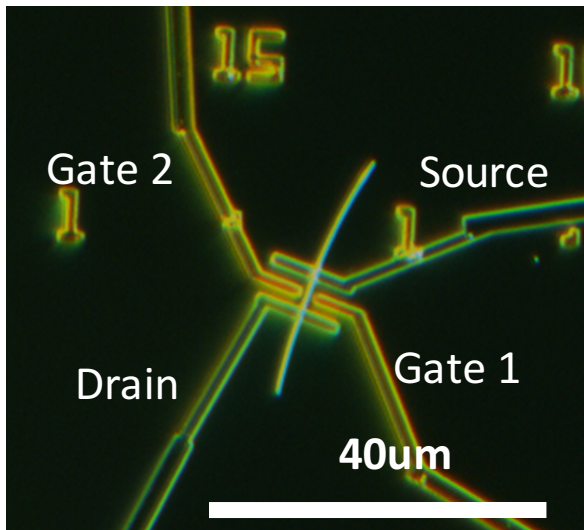


What are FET biosensors and how do they work?

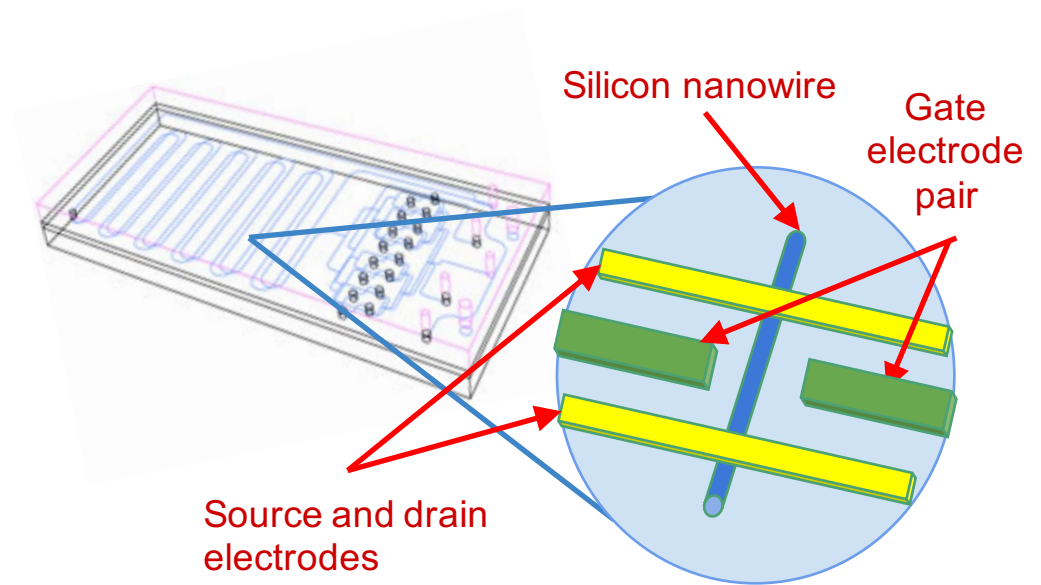


Dimensions: Silicon nanowire 30 nm in diameter, gate gap distance is 2 μm

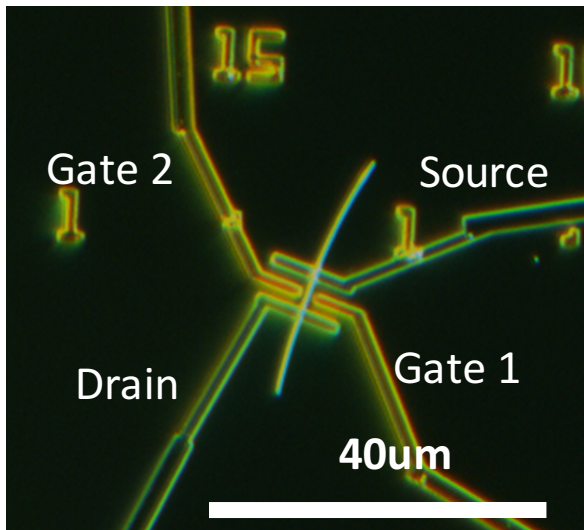
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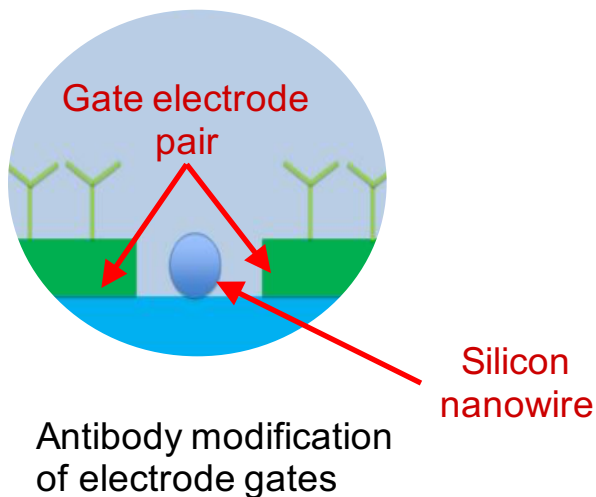
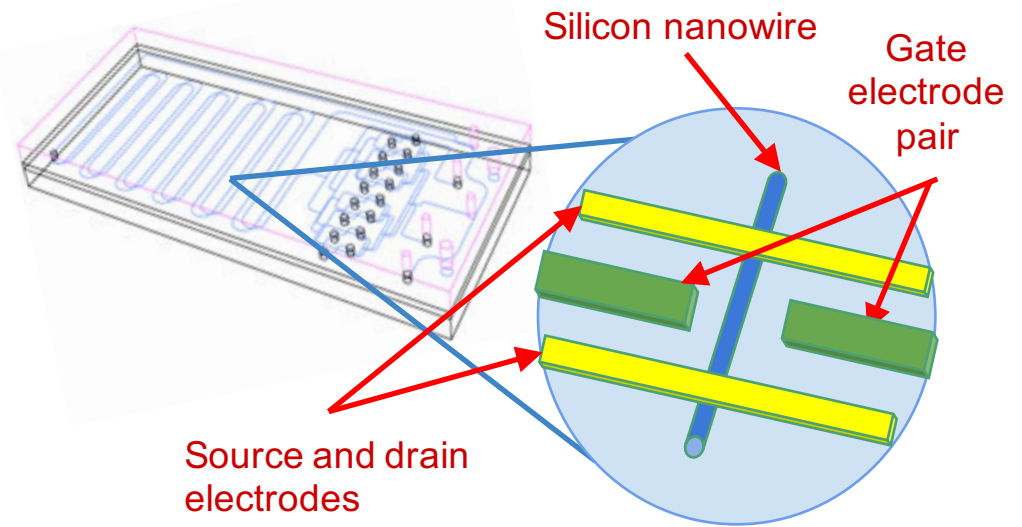
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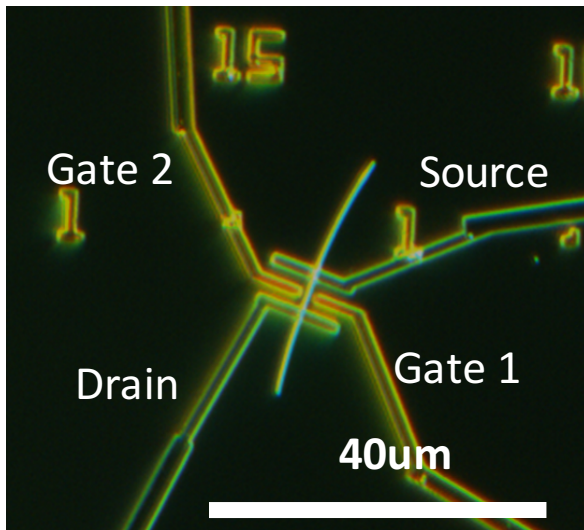
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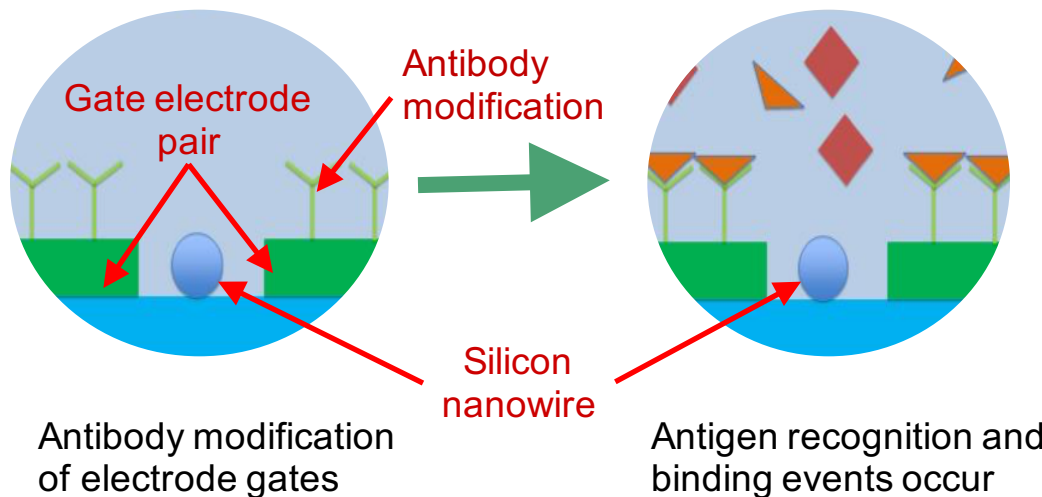
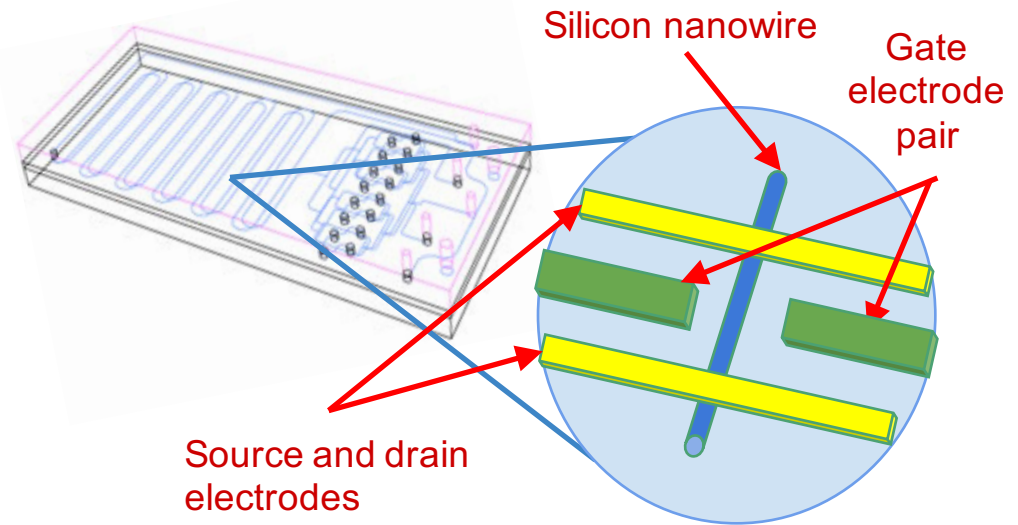
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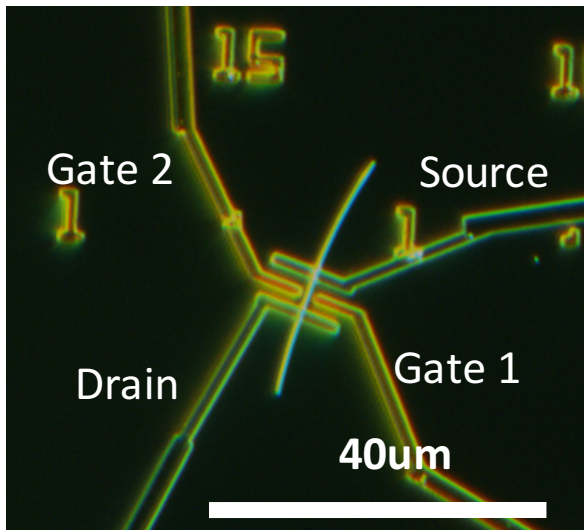
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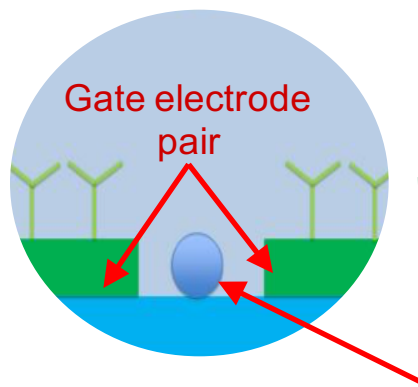
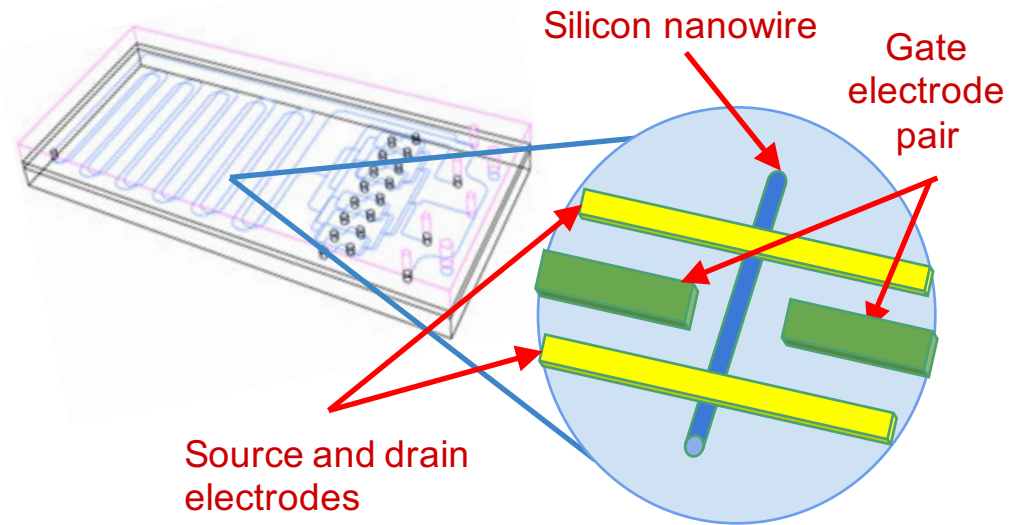
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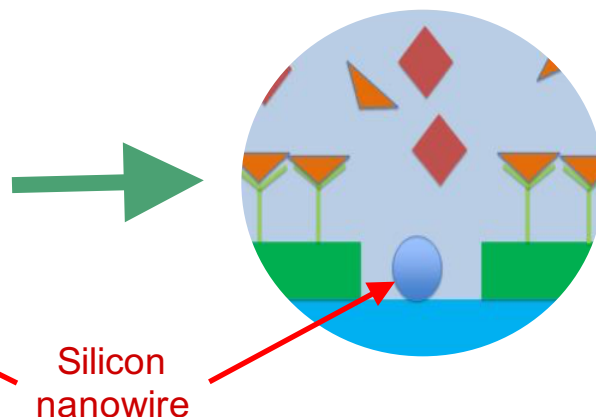
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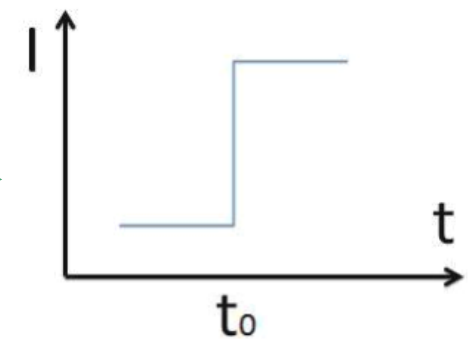
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Antibody modification of electrode gates

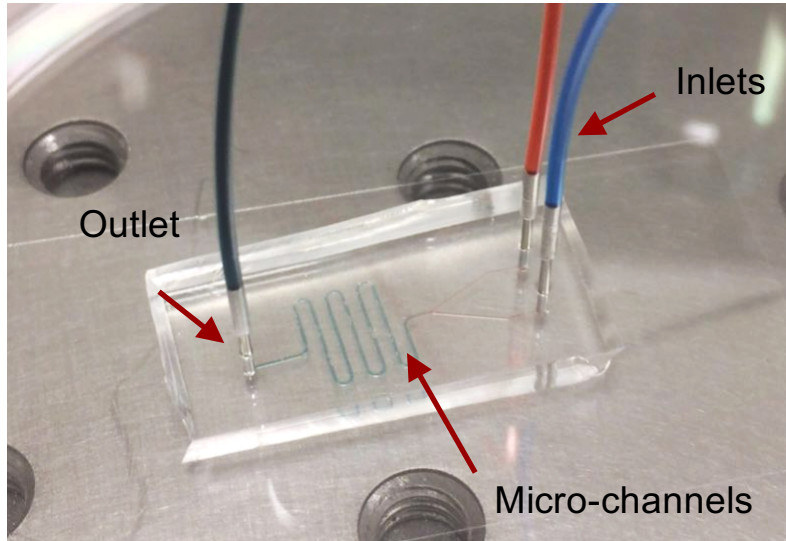


Antigen recognition and binding events occur



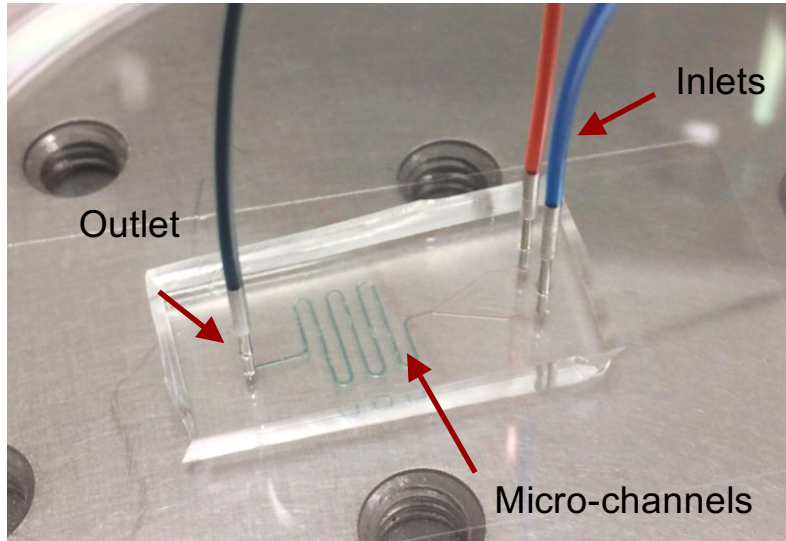
Signal change occurs when antigen flow is introduced

What is a microfluidic system and why is it useful?



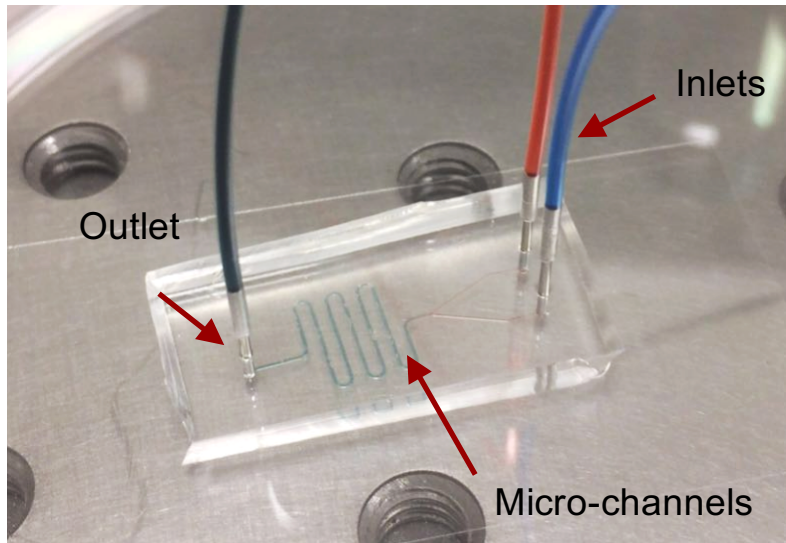
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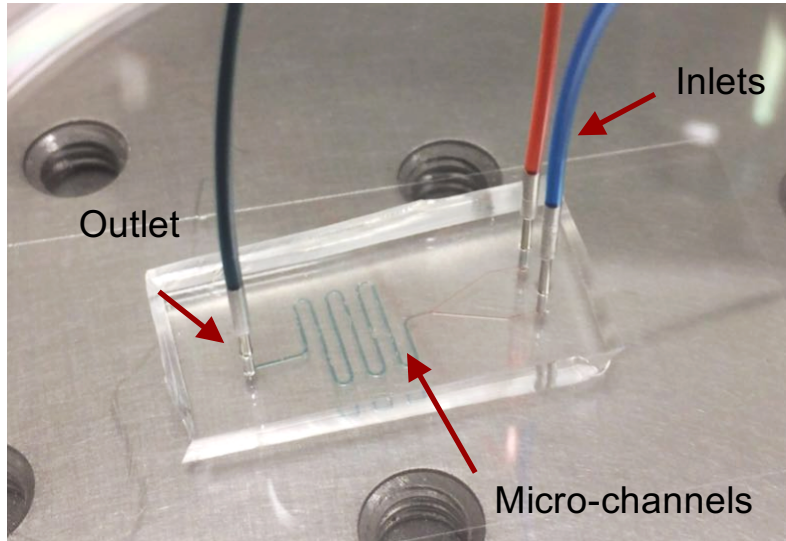
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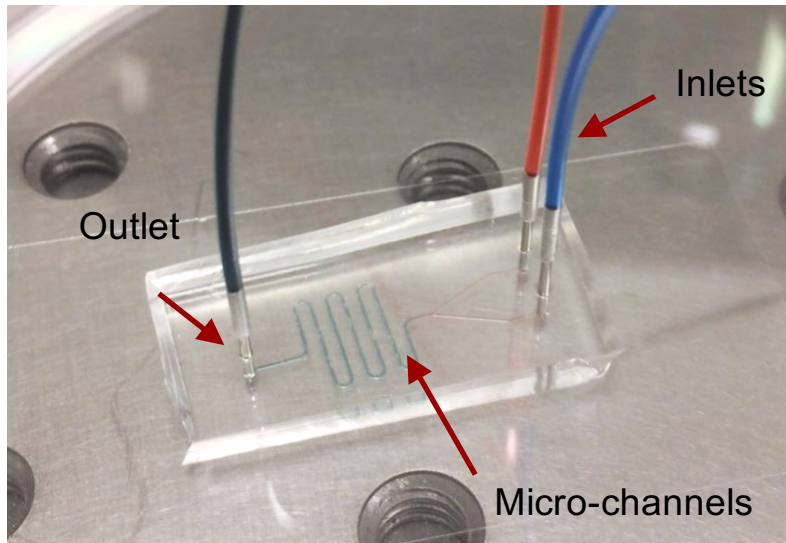
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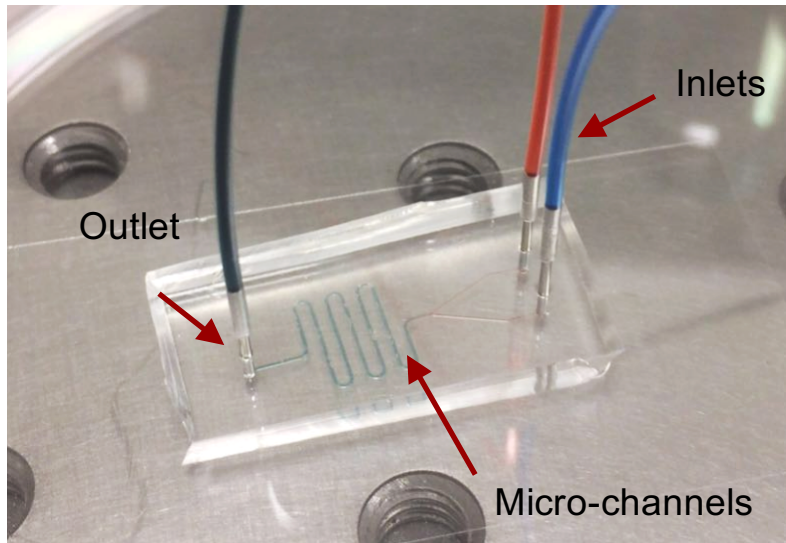
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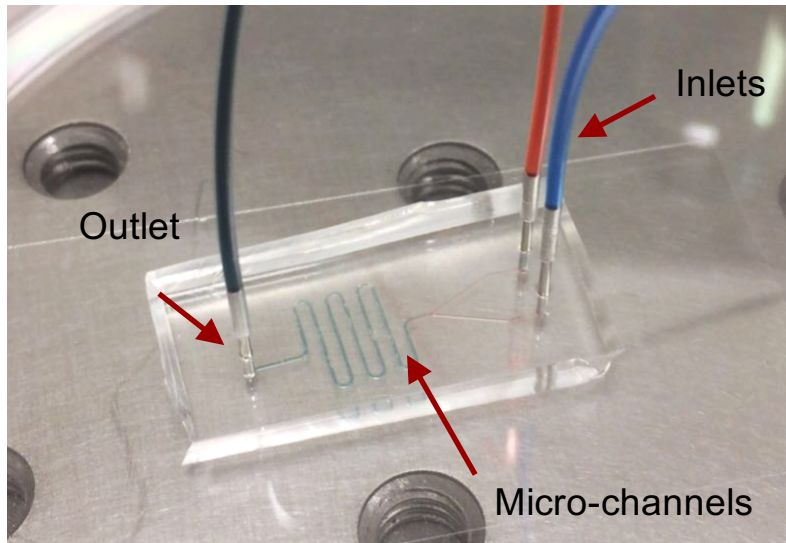
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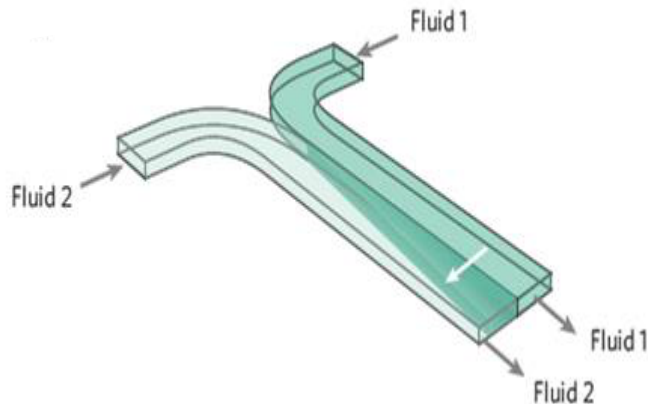


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- Used to mix, sort, and transfer fluids
- Come in various arrays of patterns and designs depending on the purpose
- Properties:
 - Inexpensive and compact
 - Multiple inputs
 - Laminar flow (diffusion mixing)

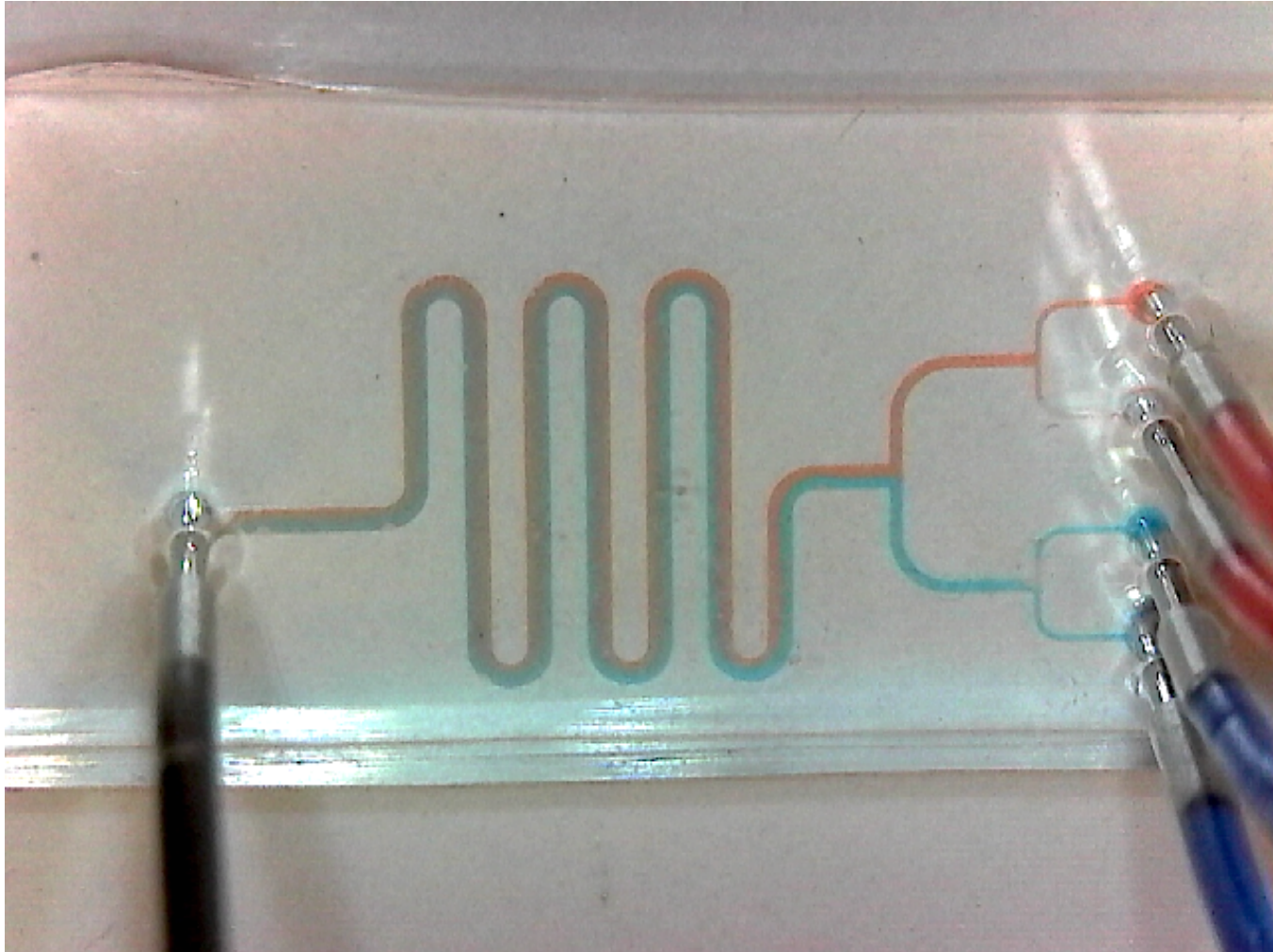


Microfluidic System Demonstration



Channel width: 50um, 100um, 200um

Microfluidic System Demonstration



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Microfluidic Chip Fabrication

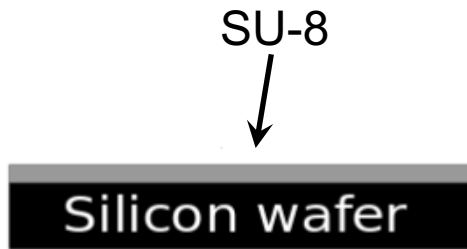
1 Coat with SU-8

SU-8
↓

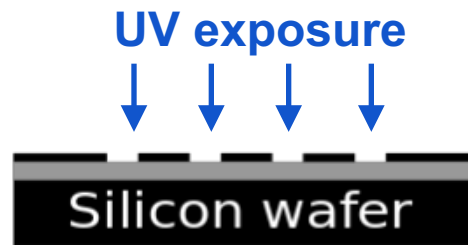
Silicon wafer

Microfluidic Chip Fabrication

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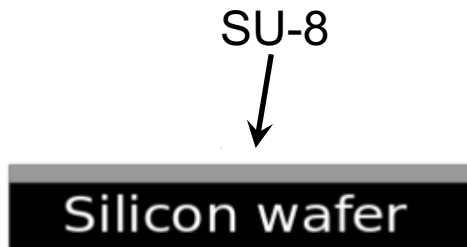


2 Place mask & expose

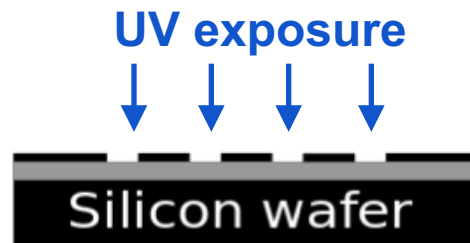


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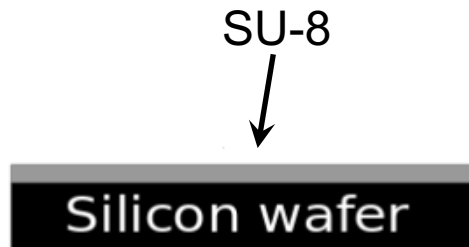


3 Wash away SU-8 and cure

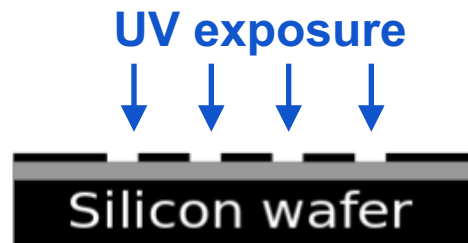


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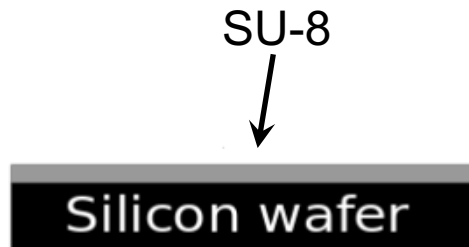


4 Pour PDMS

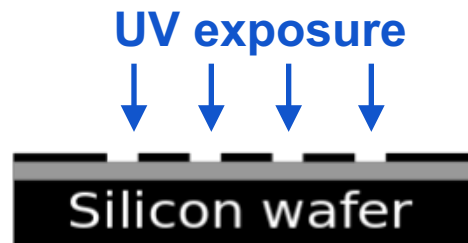


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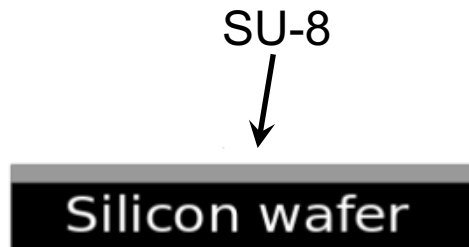


5 Peel off mold

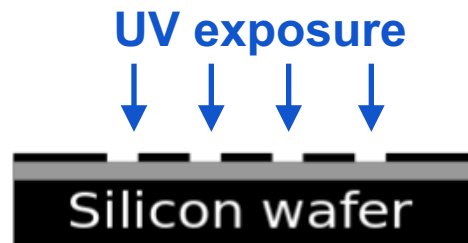


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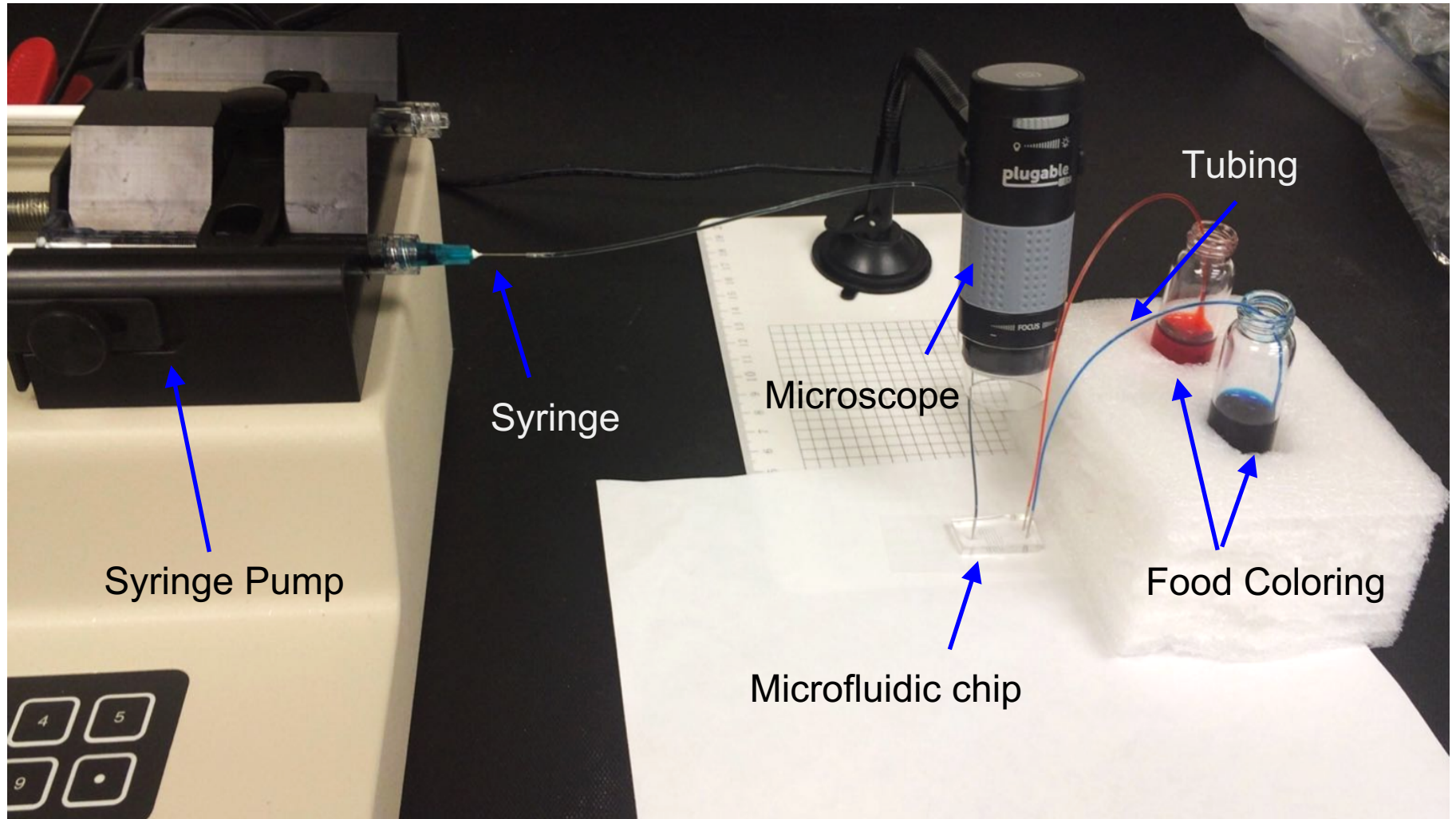
5 Peel off mold



6 Bond to glass slide



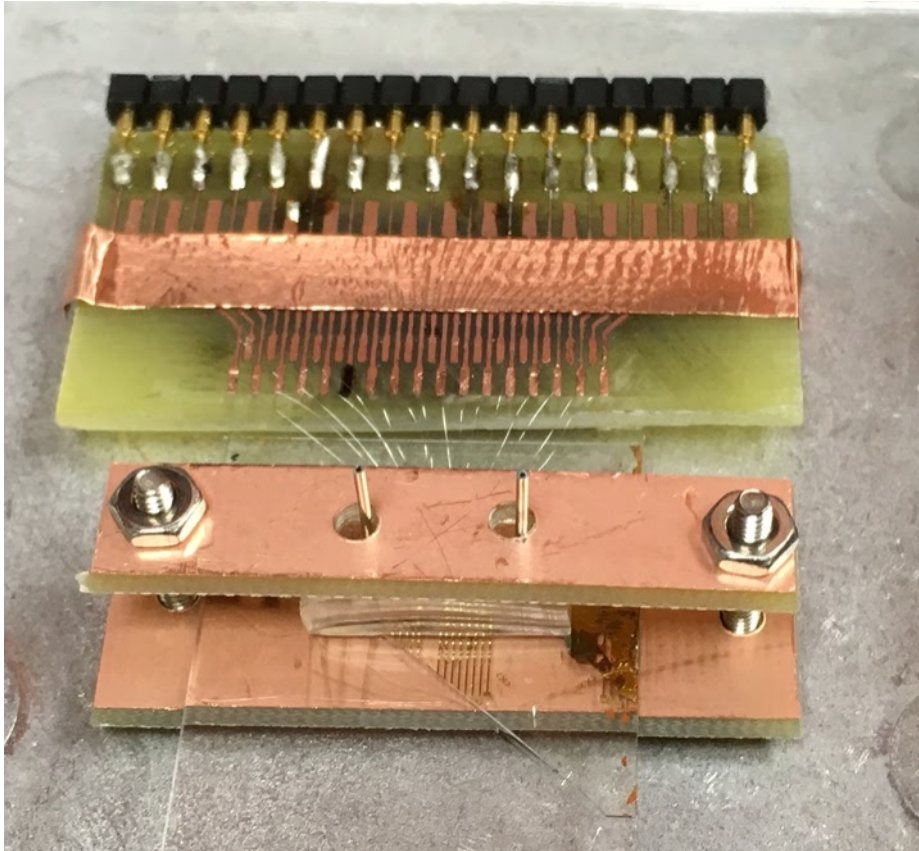
Experiment Setup



Summary of Results

We were able to fabricate a microfluidic device and show the laminar flow occurring, but we saw that diffusion did not occur inside the channel. We want calculate how long the channel must be in order for diffusion mixing of liquids to occur.

Future Experiments



- Currently we are testing the alignment and bonding of a simple microfluidic device on the nanowire FET.

Upcoming work:

- We eventually want to run some pH sensing tests on the nanowire FET biosensor. Later we will do protein recognition tests.

Acknowledgements

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Lab partners: Yuan Wang, Xiangbing Liao, Joshua Sadar

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ASU/NASA Space
Grant

Thank you for your attention!

Any Questions?

Christy Contreras

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