CD Microfluidic Device for Capture and Isolation of Cancer Stem Cells

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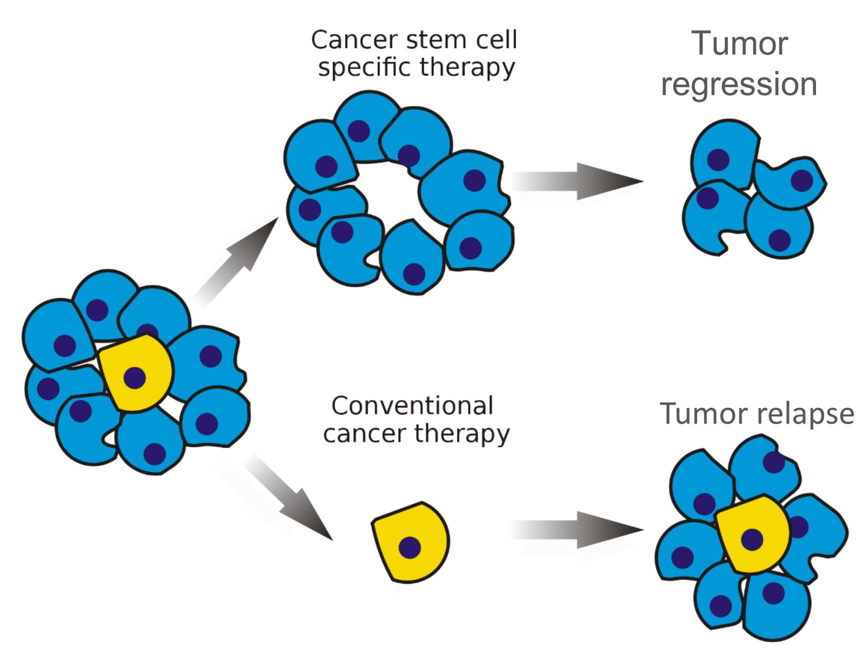
Background

Cancer stem cells (CSC) are known to be the main culprits in the promotion and formation of tumors throughout an individual's body. Though they compose approximately 3% of cancer cells, their ability to differentiate into various cell types, self-renewal and divide indefinitely prevents the successful elimination of cancer. This devices aims to help researchers track CSC's in the body in order to successfully remove cancer. More research can also be done to study CSC's specially to understand them better and come up with treatments to destroy them.



Source: en.wikipedia.org/wiki/Cancerstem_cell

Project Goals

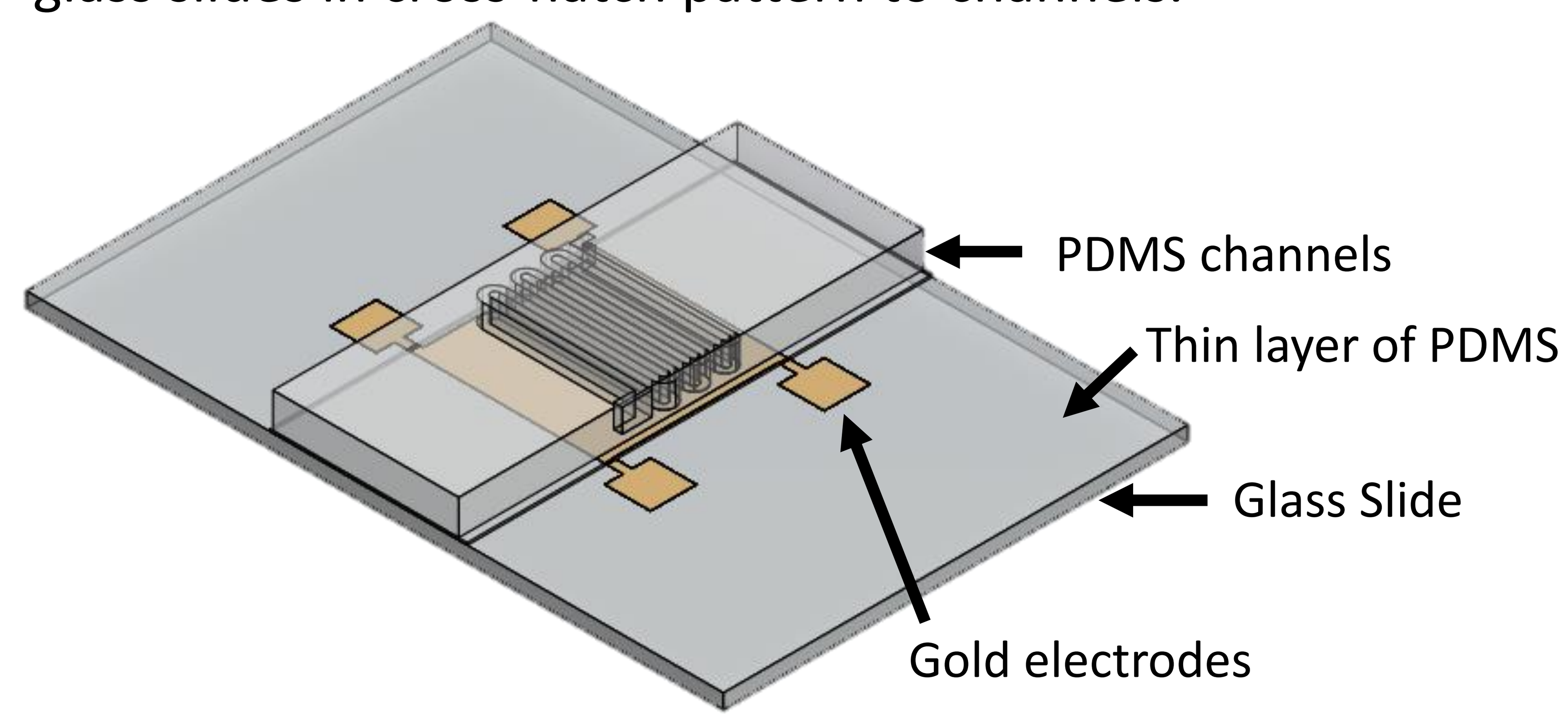
- Isolate majority of Cancer Stem Cells from non-tumorigenic cells using a process that that will separate the cells by creating a non-uniform electric field, called Dielectrophoresis (DEP).
- Separate cells based on temporal separation.
- Determine which design would provide for the best results in terms of cell separation.

Project Design

PDMS will be the primary material used to create the fluid channels. If leakage occurs, then the second method, using CNC machined plastic, will be used. The device will be spun on a CD to separate the cells based on density and will be captured based on temporal separation.

1 **Polydimethylsiloxane (PDMS) Channels**

A PDMS mold will be created for the channels. The glass slide and PDMS structure will be plasma bonded together to prevent leakages. Gold electrodes will be patterned on the glass slides in cross-hatch pattern to channels.

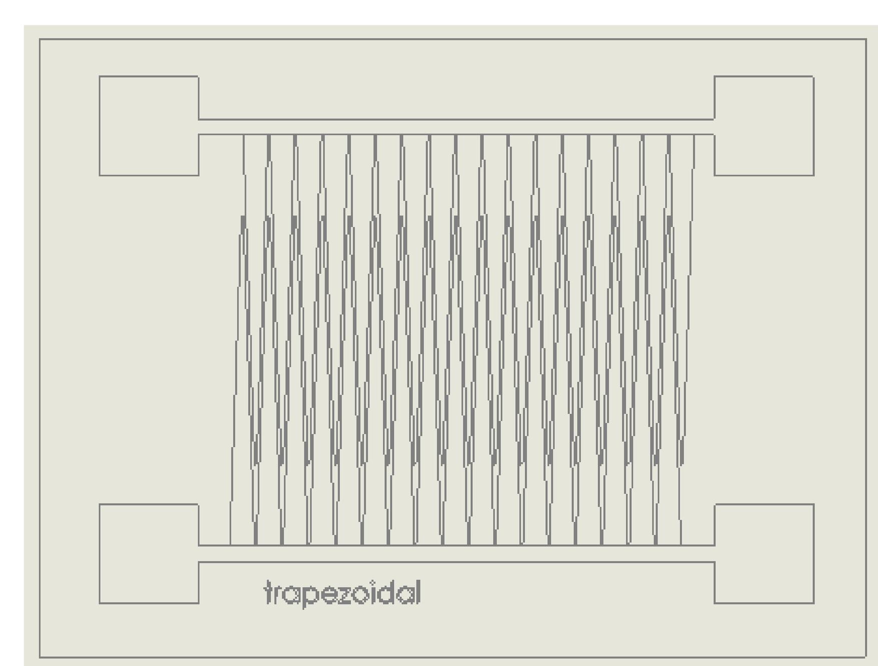


2 **CNC Machined Plastic**

The channels will be created on the glass slide and a Computer Numeric Controlled (CNC) machined plastic for the channels. It will be attached to the glass using a pressure sensitive adhesive.

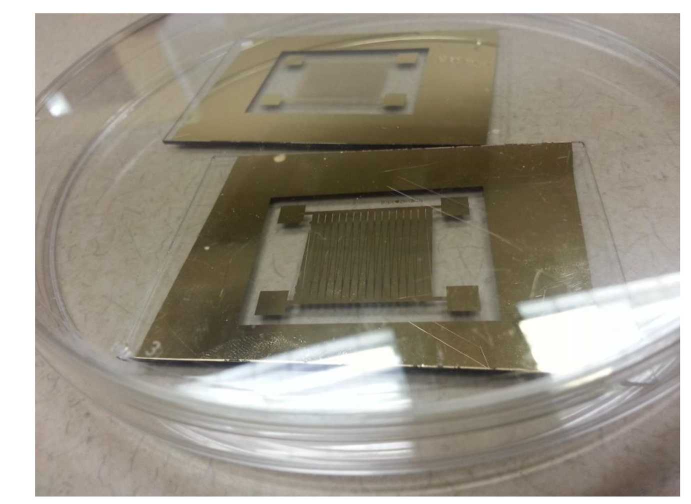
Electrodes

The electrodes will be created in trapezoidal or rectangular interdigitated arrays to determine which shape would provide for the strongest electric field.

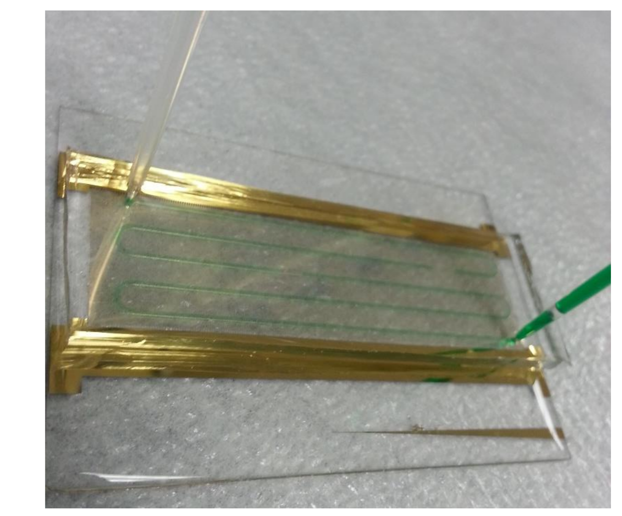


Testing Results

- Tested plasma bonding between two layers of PDMS. Fluid was able to flow through channels without leaking.

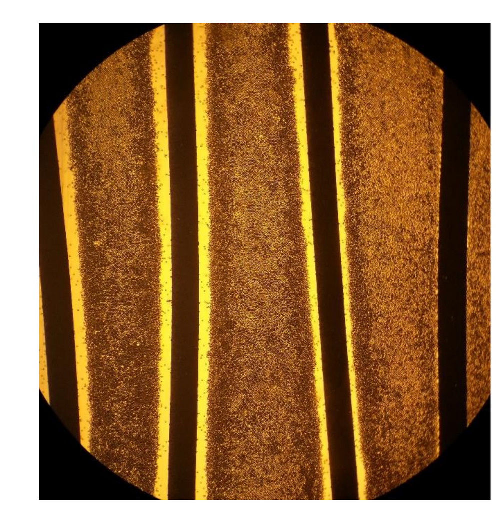


Gold electrodes on glass slides

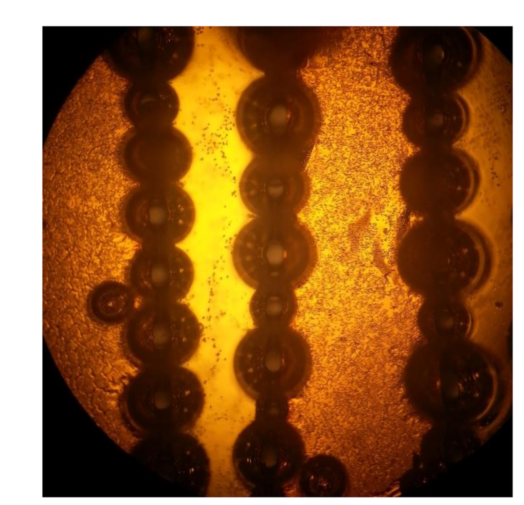


Green dyed water used to observe flow through PDMS channels.

- DEP observed using polystyrene beads with applied frequency and voltage.
- At high voltages, hydrolysis occurred so the optimum frequency and voltage ranges needed to be determined.
- For the trapezoidal electrodes, ranges of frequency and voltage where DEP was observed: f=2500 Hz, Vpp= 4 V
- For the rectangular electrodes: f=15.3 kHz, Vpp= 0.2 V



Separation of polystyrene beads on trapezoidal electrodes.



Hydrolysis observed by formation of bubbles on the electrodes.

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