NANOELECTRONIC SENSOR FOR DETECTION OF PROSTATE CANCER

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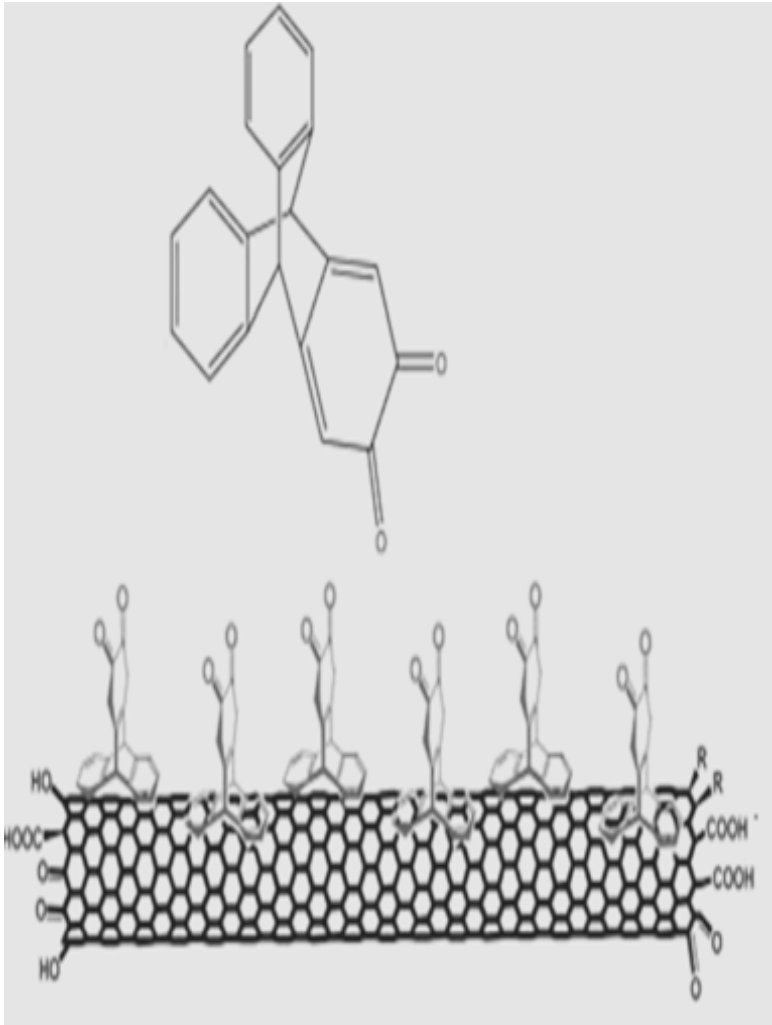
MOTIVATION

- From 1999-2005 only 68% cancer patients survived
- Prostate cancer is the second most common cause of cancer death in American men
- Approximately 215000 new cases of prostate cancer are anticipated in 2010
- Current methods of detection are either invasive or require high concentrations of the biomarker in order to detect accurately

American Cancer Society

GOALS

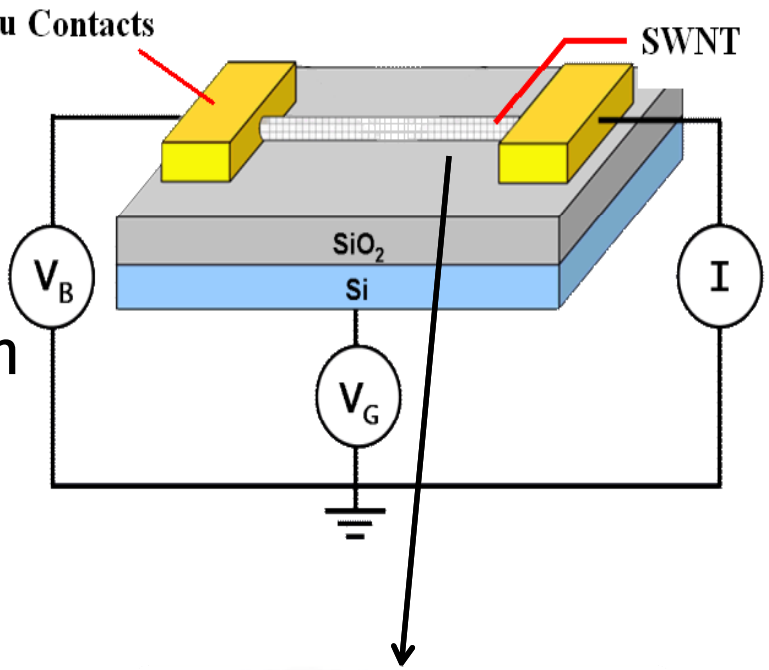
- To fabricate SWCNT FETs
- To attach prostate cancer antibodies to SWCNTs
- To attach prostate cancer biomarker to antibodies
- To electrically sense prostate cancer biomarker attached to SWCNTs
- To design a channel that allows us to flow fluid with prostate cancer biomarker through the SWCNT while taking electrical data

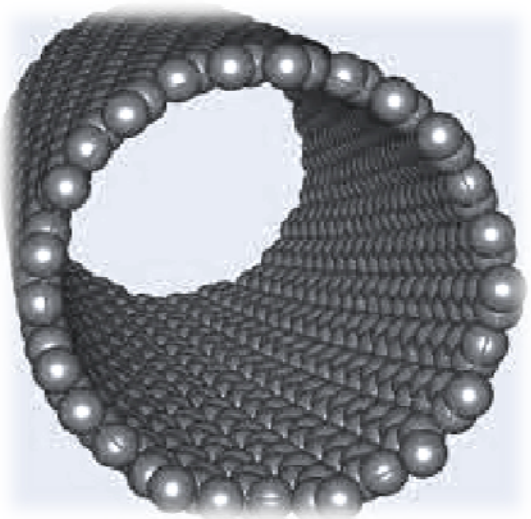


WHY SWCNT FETs?

Semiconducting SWCNTs

- Highly sensitive, every atom is exposed
- Highly specific, after chemical functionalization
- Due to its size, it senses small concentrations of biological molecules of interest

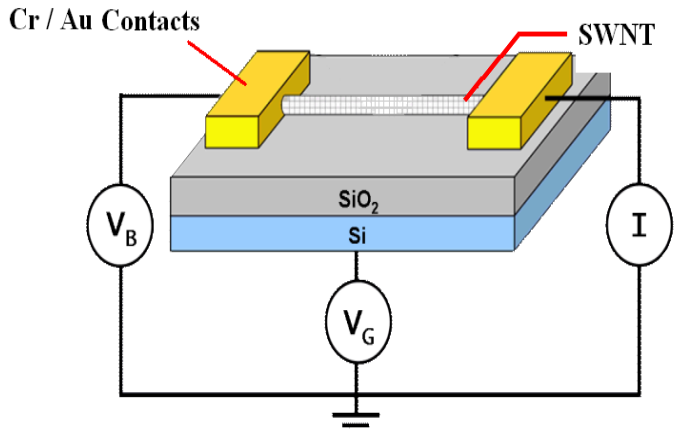


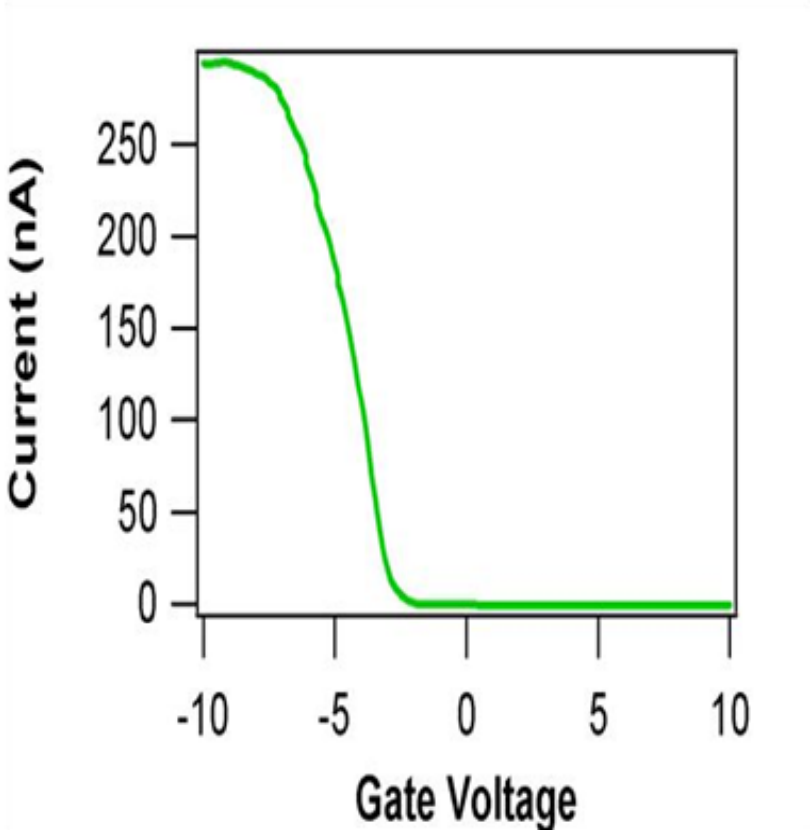


WHY SWCNT FETs?

FETs

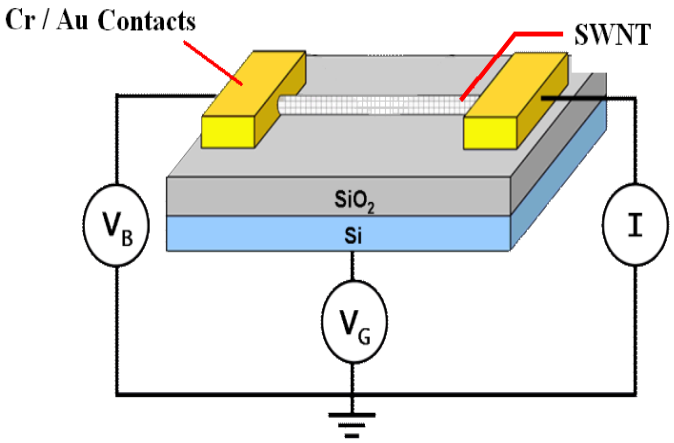
- Allow us to measure current through the SWCNT when gate voltage is applied
- Allow us to measure small changes in current as the gate voltage varies

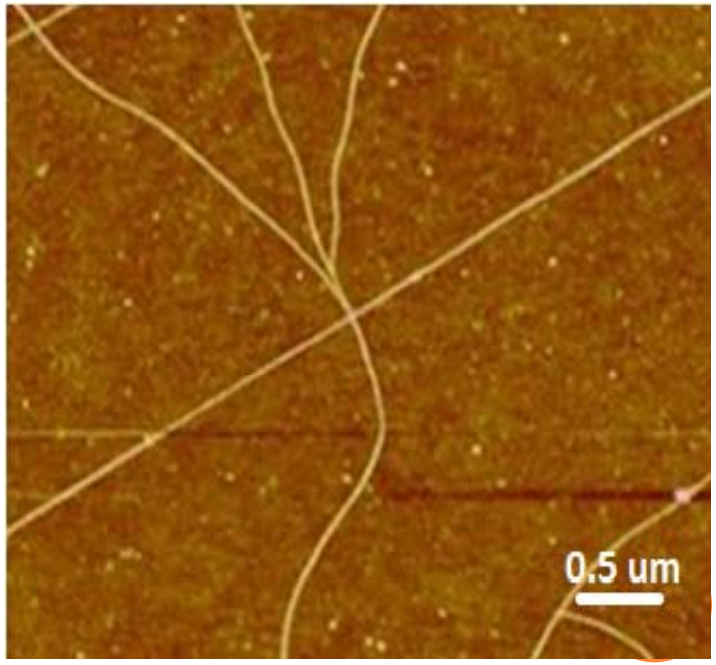




SWCNT FET FABRICATION

- Si/SiO2 wafer plasma cleaning
- Dispense of Catalyst
- Synthesis of CNT by chemical vapor deposition
- Imaging with AFM
- Photolithography
- Metal deposition
- Liftoff
- Electrical probing

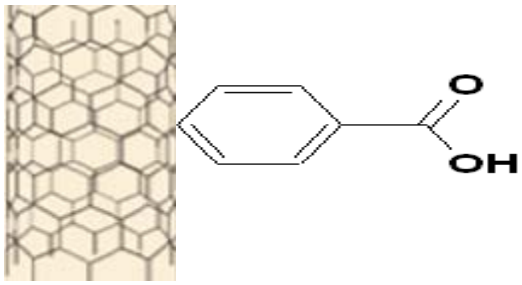




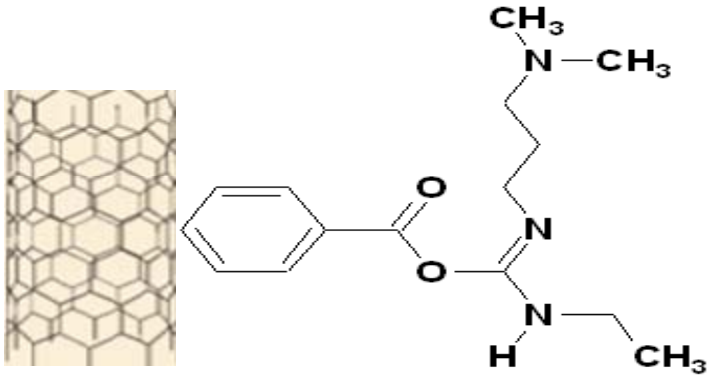
FUNCTIONALIZATION

- Oxidation by diazonium
- Chemical processing EDC, NHS, MES buffer
- Attachment of prostate cancer antibody
- Exposure of prostate cancer biomarker (key lock mechanism attachment)

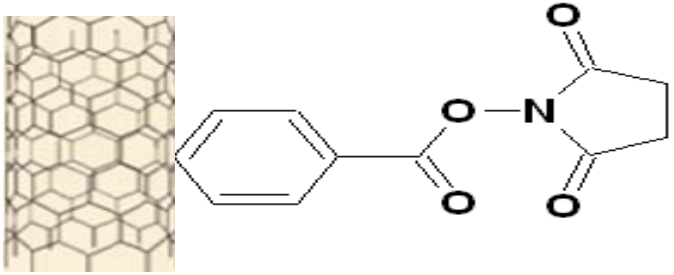
Oxidation



Unstable COOH Activation

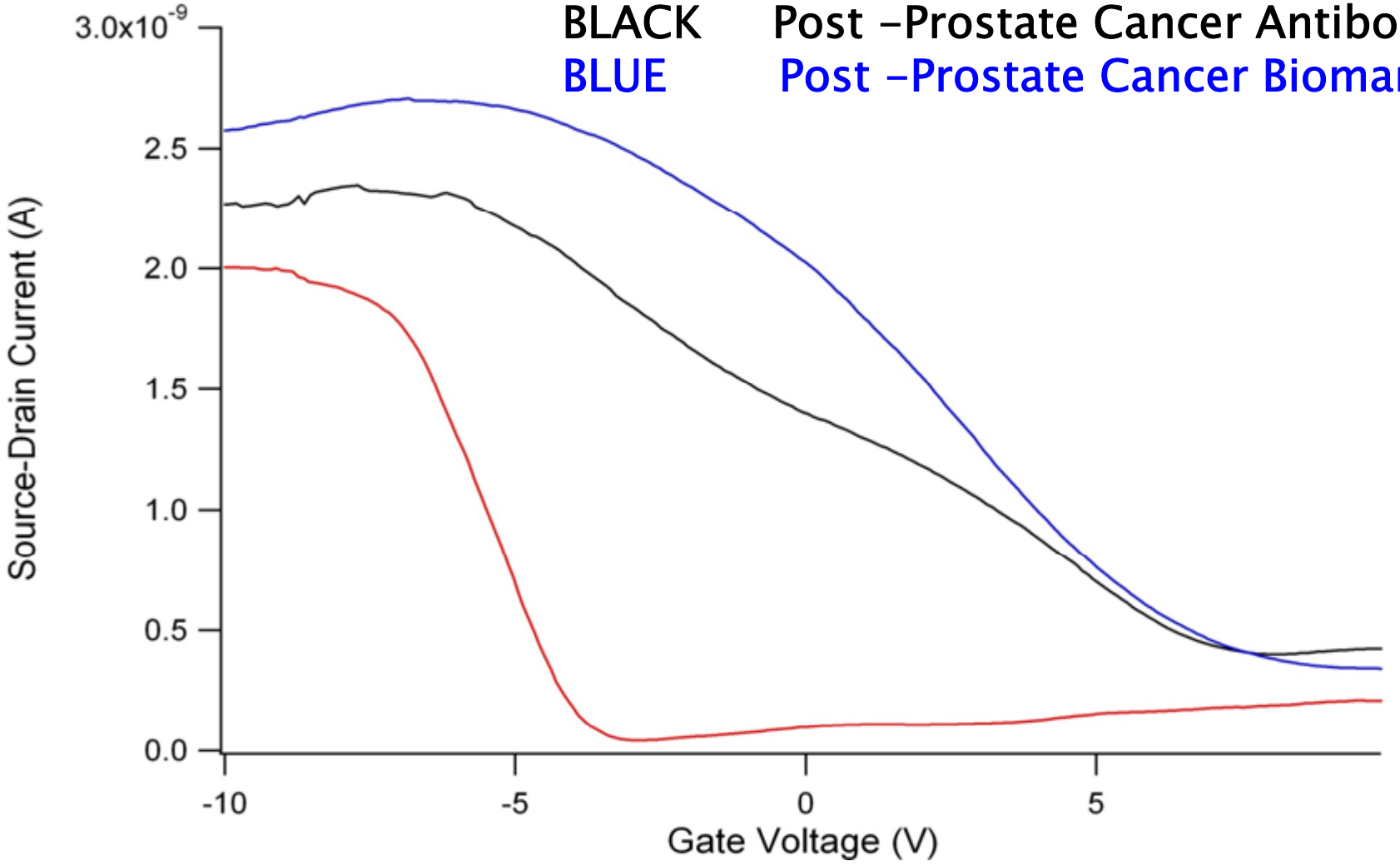


Stable COOH Activation

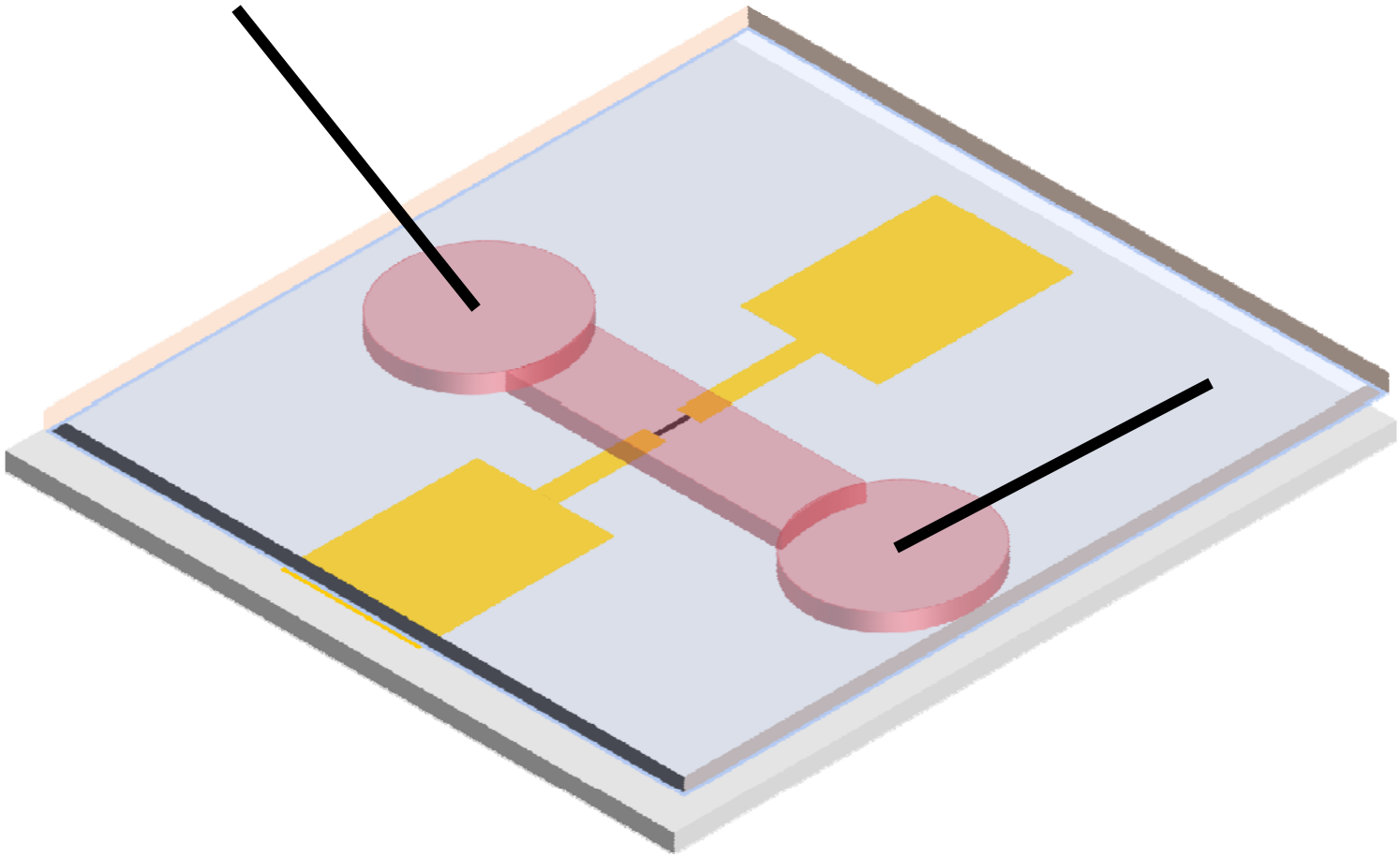


ELECTRICAL DATA

RED Pristine SWCNT
BLACK Post –Prostate Cancer Antibody
BLUE Post –Prostate Cancer Biomarker

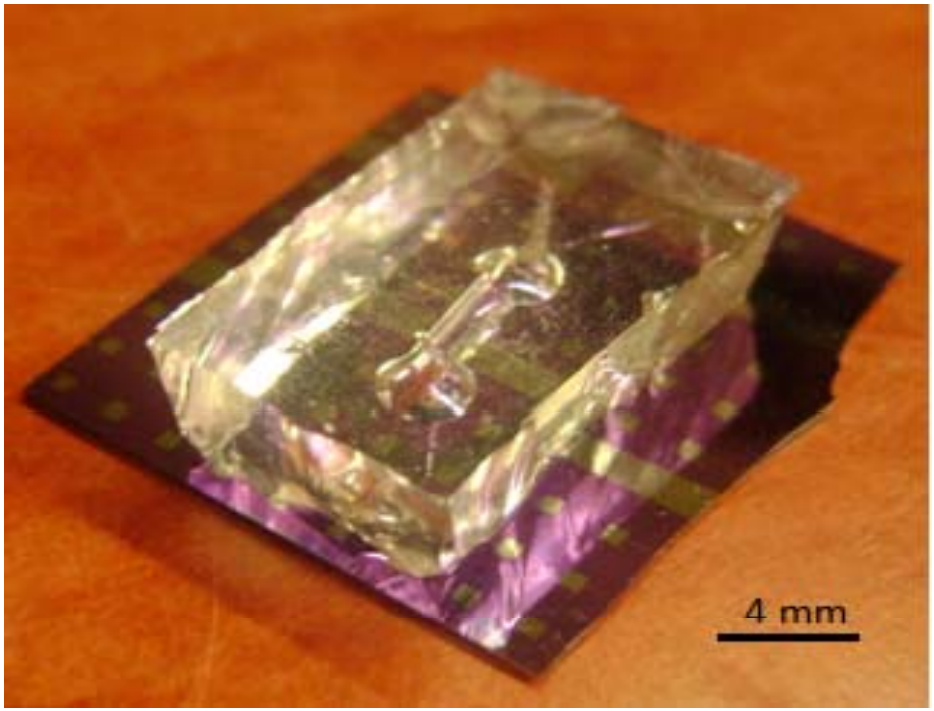


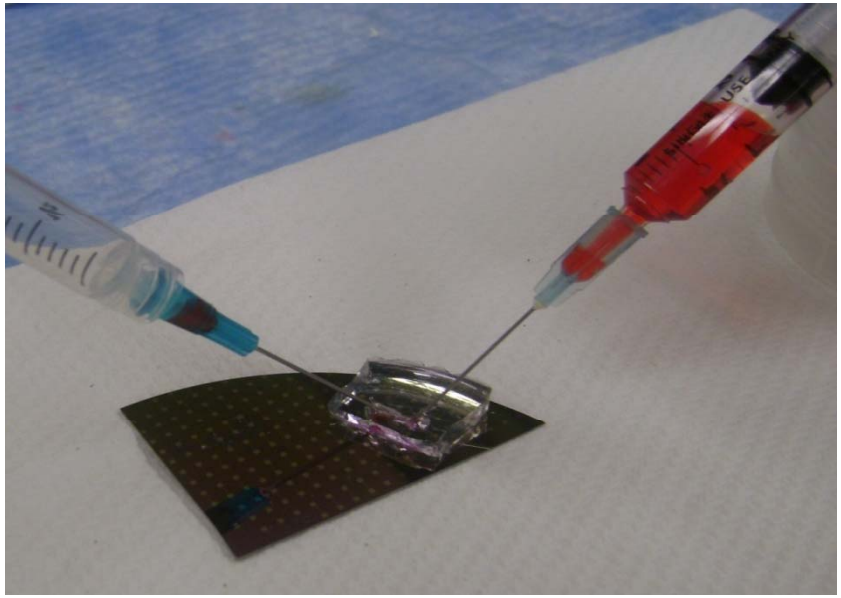
FLUID HANDLING



FLUID HANDLING

- Channel between the electrodes
- Fluid goes in and out without any leakage!





FLUID HANDLING

Channel mold

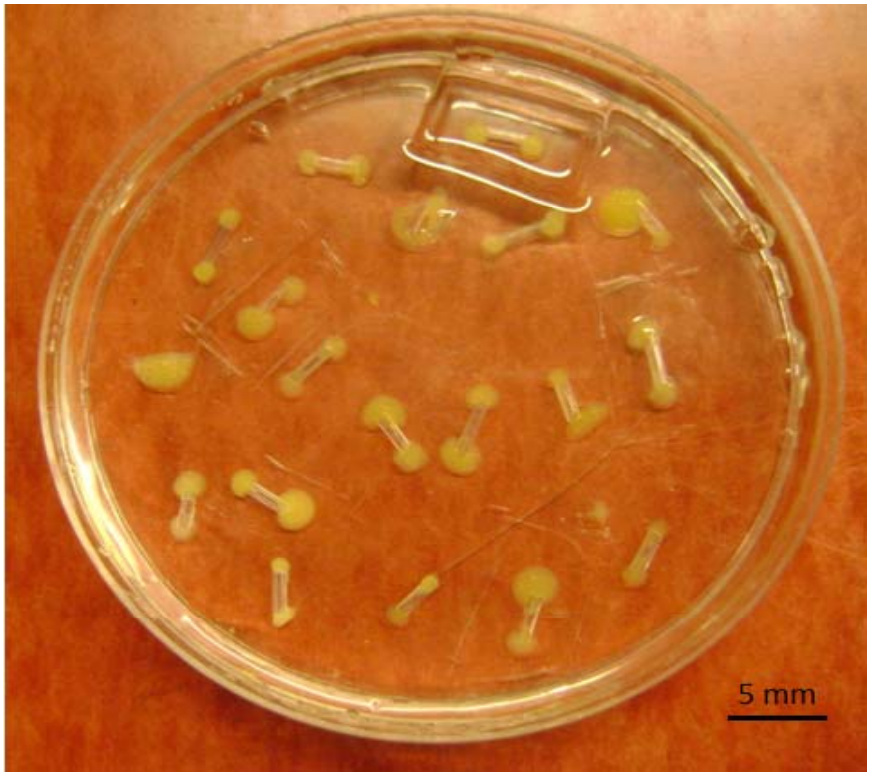
- Materials

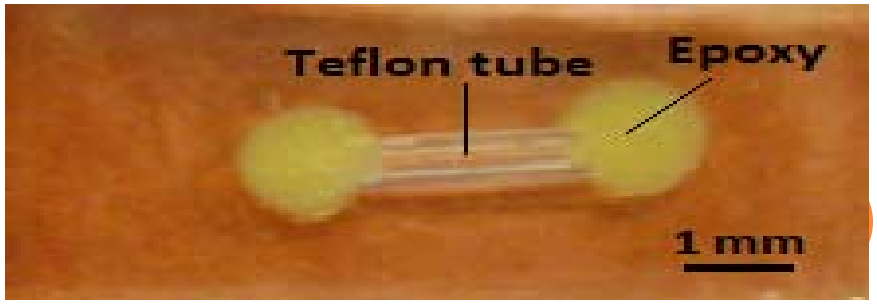
  Plastic Petri dish, epoxy, Teflon tubing

- Channel–4mm x1mm

  wells–~1.5 mm diameter

  1.5 mm height

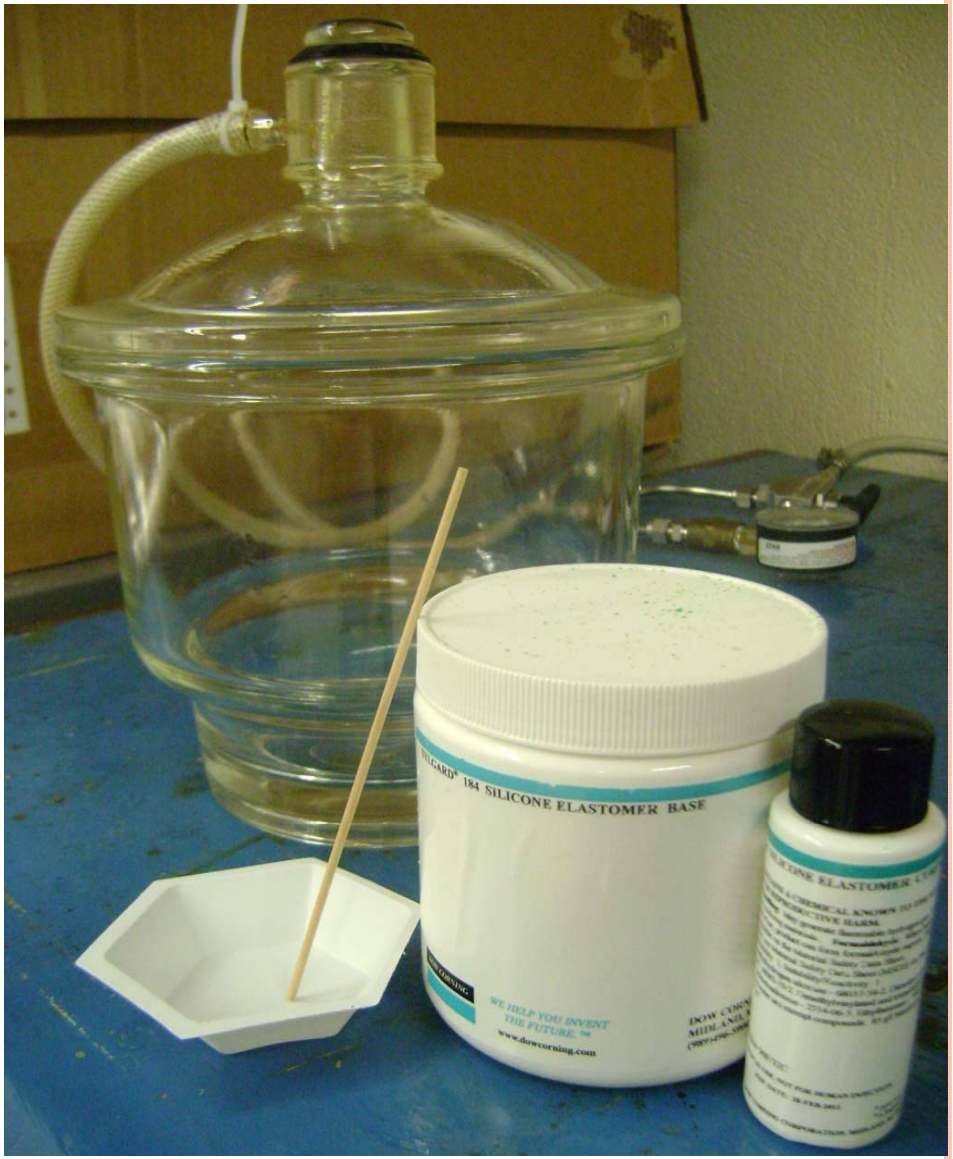




FLUID HANDLING

Elastomeric channel

- PDMS sylgard 184
- Pour over channel mold
- Degas PDMS in a dessicator connected to a vacuum
- Cure for 2.5 hours at 70° C



CONCLUSIONS

- SWCNT FET were fabricated successfully.
- Functionalized devices after exposed to prostate cancer biomarkers show a change in IVg curve. More electrical data need to be taken to characterize this change.
- The channel designed allowed us flow fluid over the nanotube device without leakage. More experiments are needed to reproduce results and acquire real time electronic readouts.

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