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)
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 x 1mm
  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 70º 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 to 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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