

The slide features a light yellow background with a decorative border of thin green lines. A vertical line runs down the left side, and a horizontal line runs across the top. A small green circle is positioned at the top-left corner where these lines meet. Another vertical line runs down the right side, and a horizontal line runs across the bottom. A second small green circle is positioned at the bottom-right corner where these lines meet.

Label Free Bio-Sensors

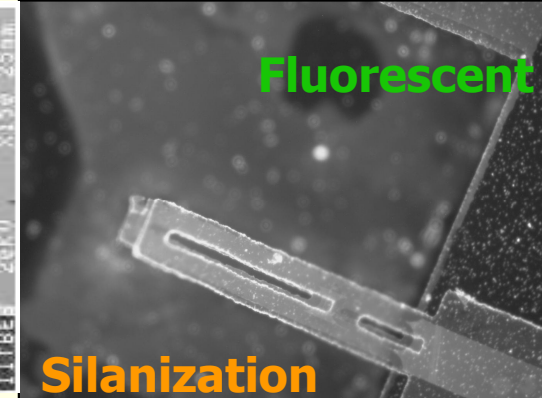
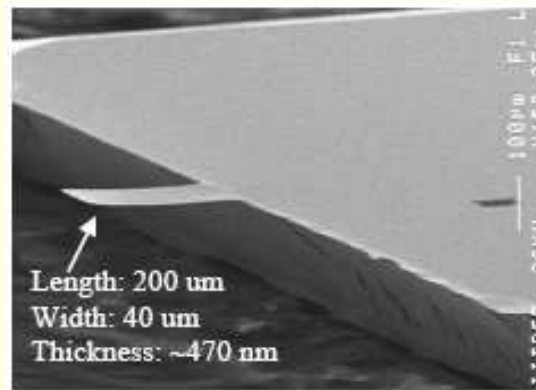
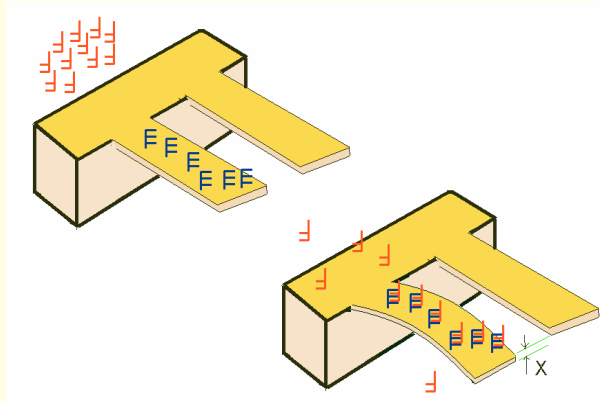
@ IIT Bombay

Prof. Soumyo Mukherjee

Motivation

- Large rural population.
- Low density of medical care and diagnostic facilities mean that people have to travel large distances to avail of simplest of them.
- Waste of time and money.
- An important causative factor for entry into BPL category.
- Develop sensing platforms that can be deployed in a wide scale.
- Inexpensive and simple enough so that panchayat's can afford and use these for health and environment.

Microcantilever Based Biosensors



SiO₂ Cantilever

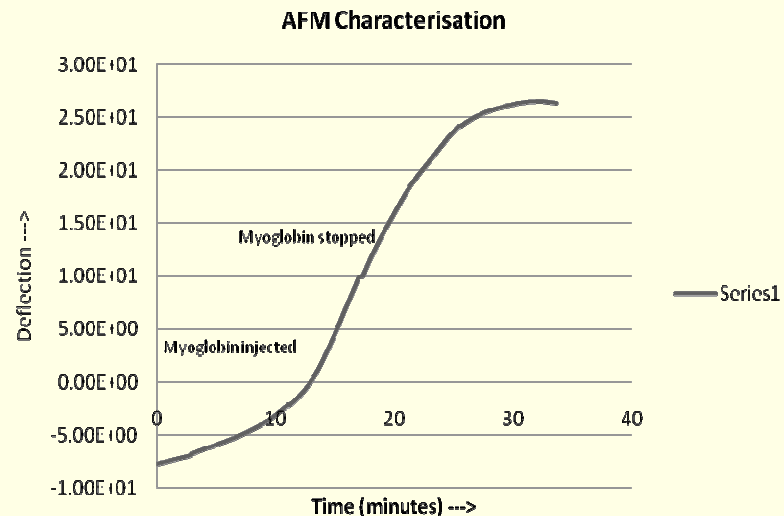
SU-8 with immobilization

Cantilevers can be created by adopting process technologies developed for microelectronics.

Some of the world's thinnest cantilevers fabricated in IITB (120-150 nm thick)

Special protocols for bio-functionalization of SiO₂, SiN and SU-8 developed.

Deflection measurements by optical or piezoresistive means



Label Free Fiber Optic Biosensors

Goals and Potential Impact

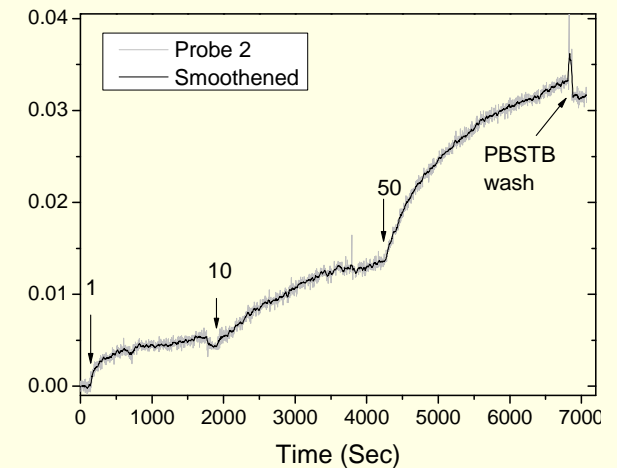
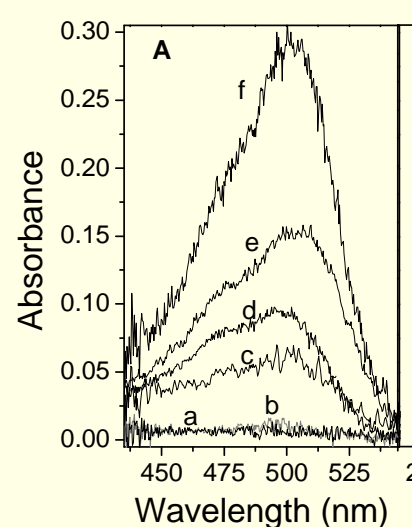
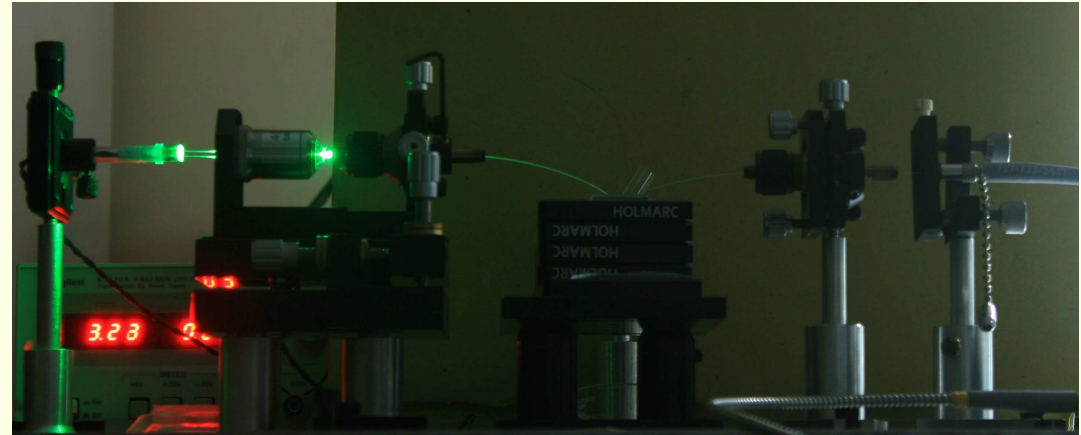
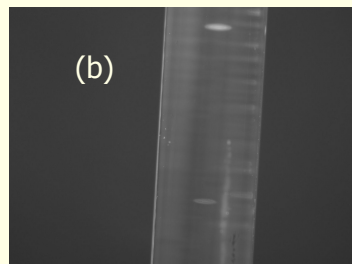
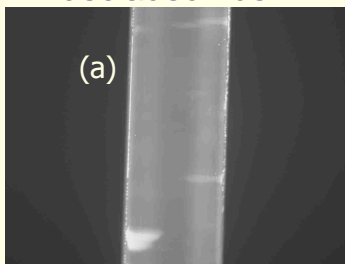
Overall Goal: To develop an optical immunosensor to detect pathogens in any given liquid medium (ex., water and food) for field use.

Present achievement: Have developed an Evanescent wave (280nm) absorbance based system

Potential Impact: For environmental monitoring in detecting the presence of harmful biological species.



Bioreceptors bound to de-clad fiber



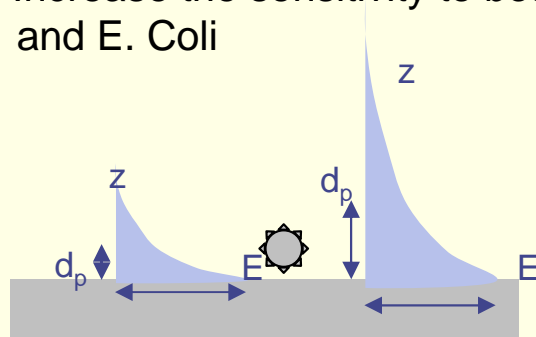
Conclusions

Sensitivity towards HIgG about $1\mu\text{g/ml}$.
Towards E-Coli not so good.

U-Bend Fiber Optic Biosensors

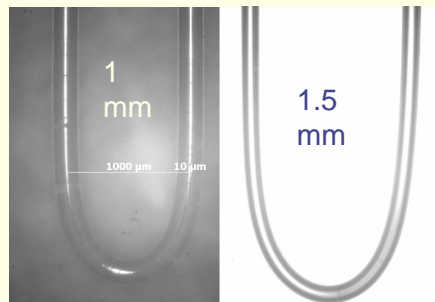
Goals

Increase the sensitivity to both proteins and E. Coli

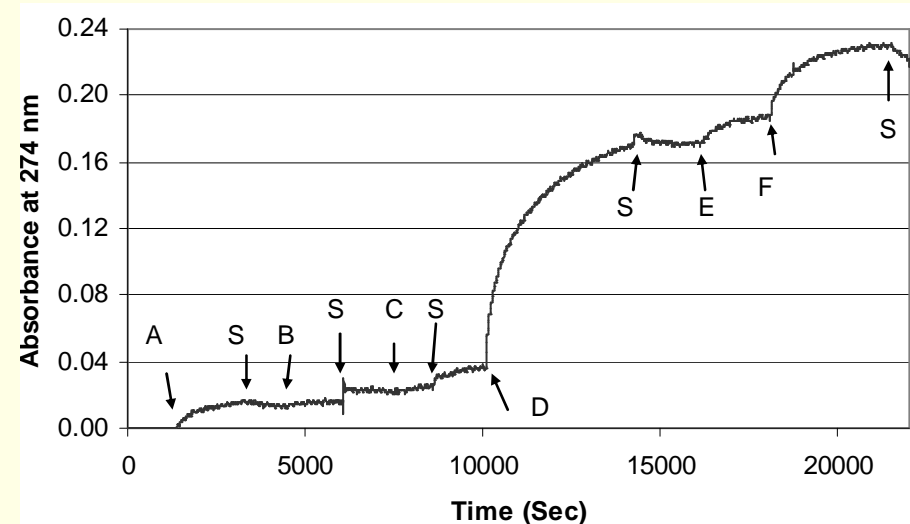


Straight

Bent



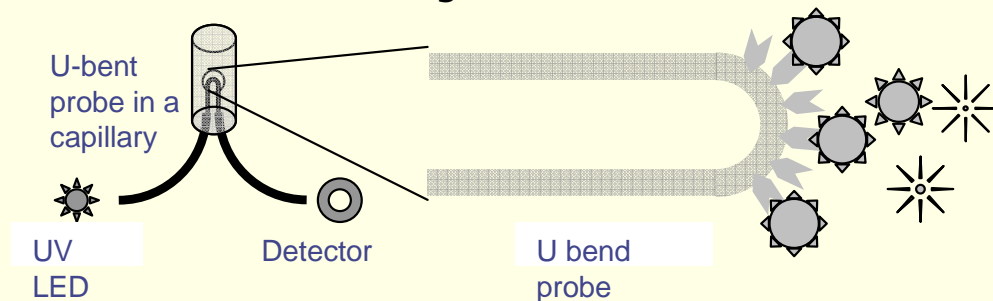
Probes bent using candle flame



A, B, C, D, E, F and S represent introduction of 15×10^2 , 15×10^3 , 15×10^4 , 15×10^5 , 15×10^6 , 15×10^7 cells/ml and saline respectively.

Conclusions

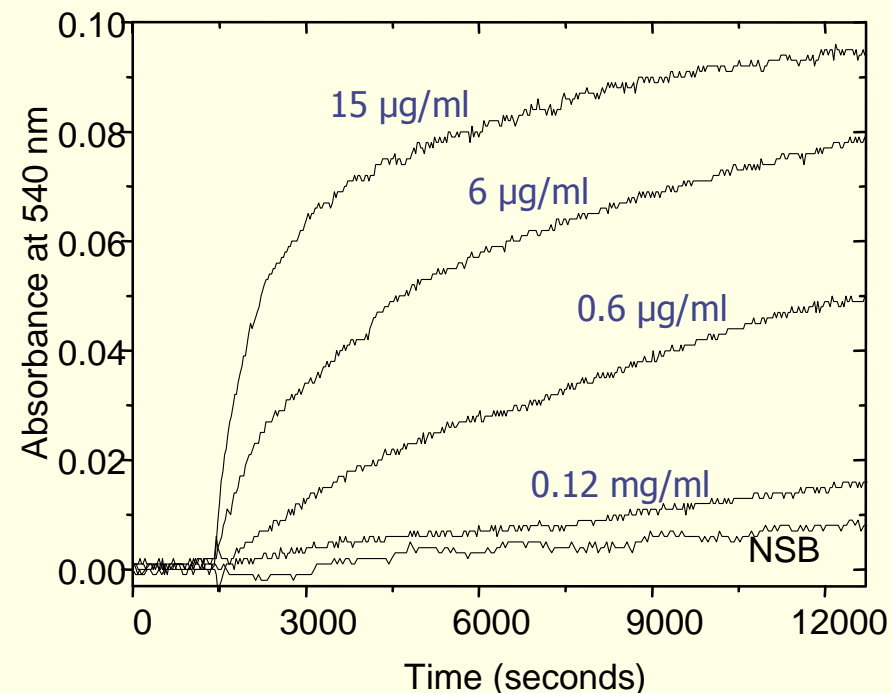
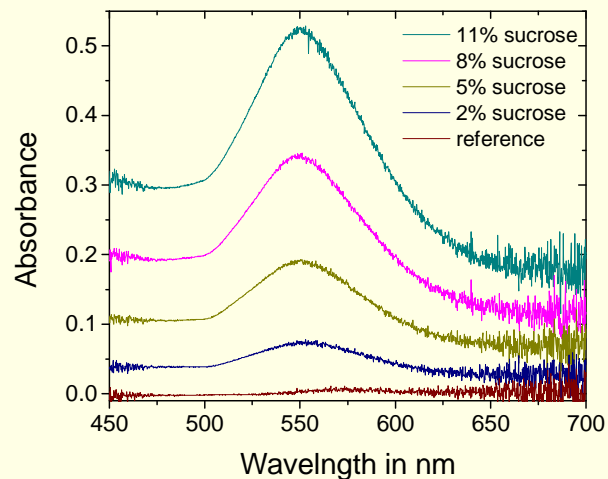
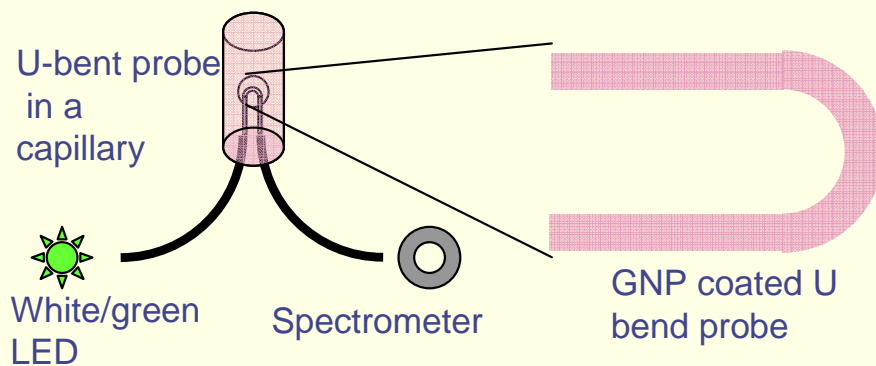
Sensitivity towards E.Coli about 1000 cells/ml. So assuming a 20 minute doubling time detection is possible in about 4 hours with a start of about 3 cfu/ml



GNP Coated U-Bend Fiber Optic Biosensors

Goal

Alternative to UV EWA based sensors. Works in visible region (540nm) and uses phenomenon of LSPR. (lower cost.)

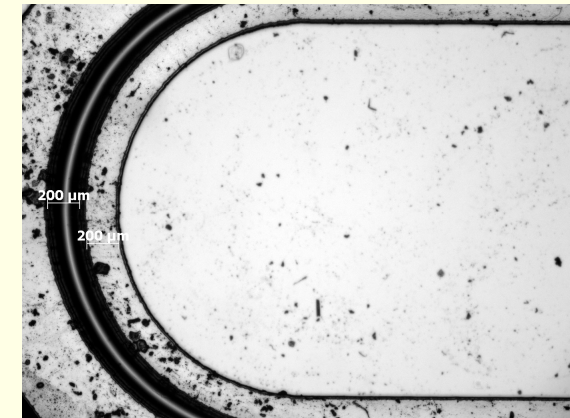
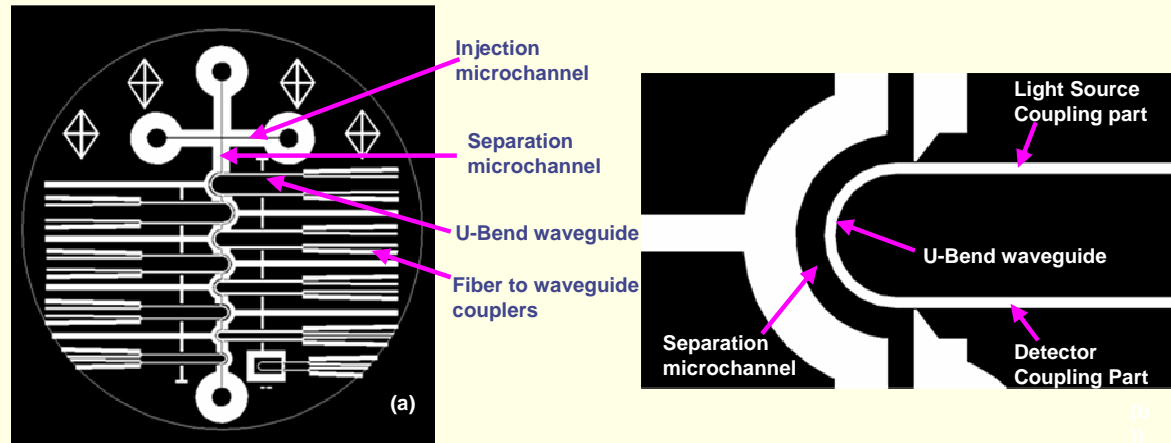


Absorbance changes monitored at 540 nm caused by binding of anti-human IgG to human IgG immobilized GNP coated U-bent fiber probes of 0.5mm bend radii. NSB data from absorbance due to non-specific binding of anti human IgG to rabbit IgG immobilized probe.

Now developing Embedded Waveguides with Microchannels to exploit the same phenomenon.

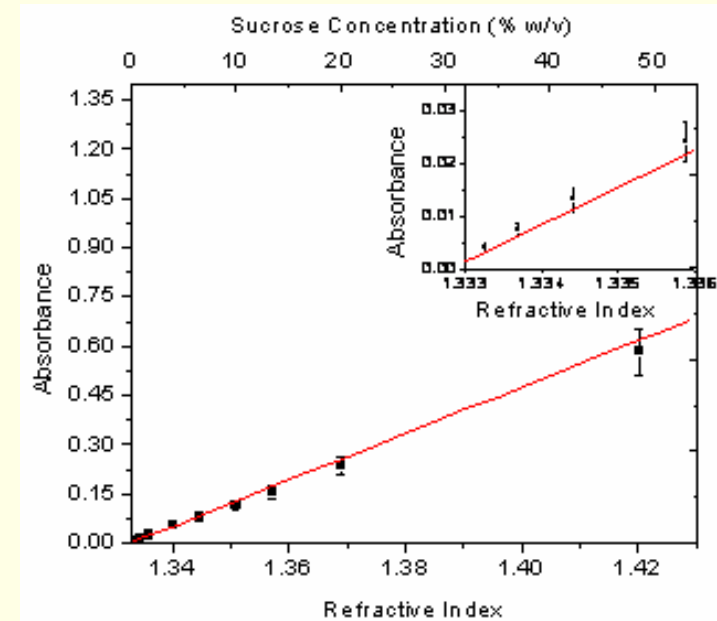
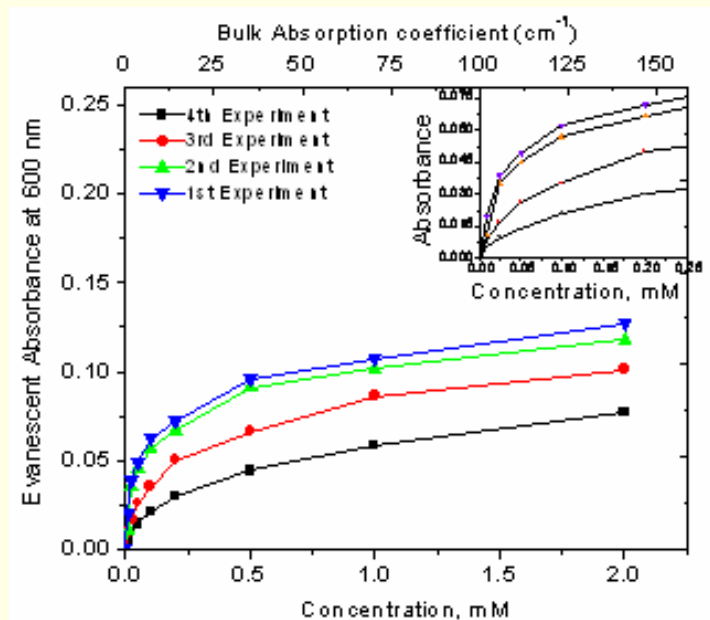


Embedded Polymer Waveguide Biosensors



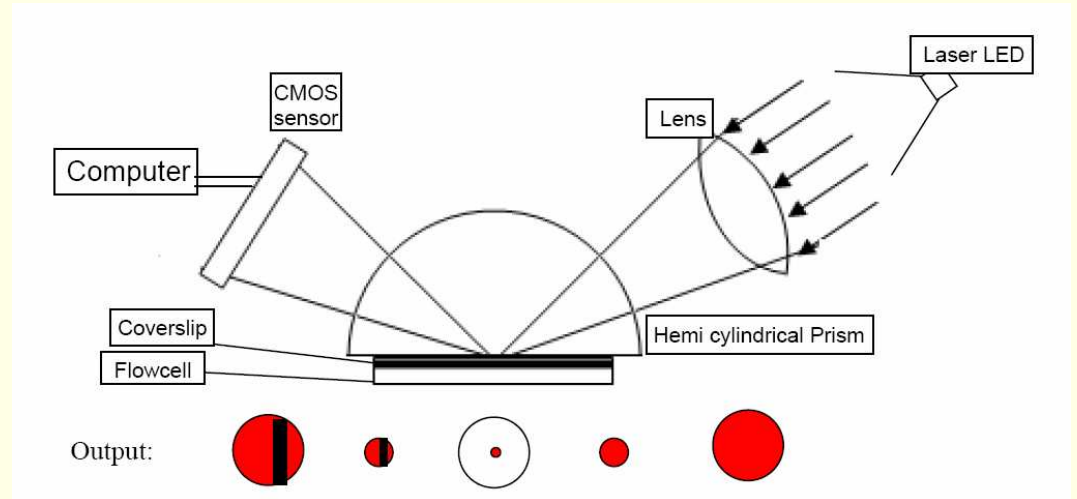
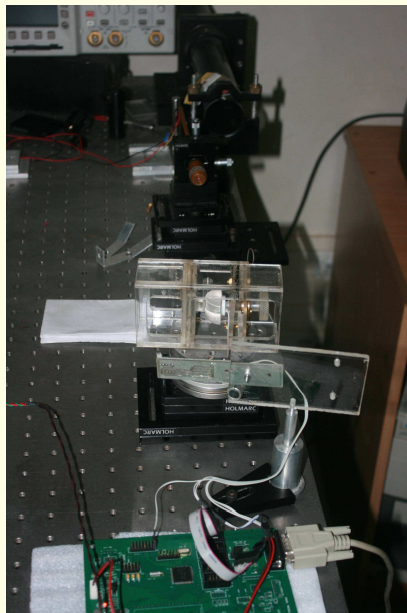
Fabricated Microchannel

Mask design of device and a closer view of microchannel interfacing with U-bend waveguide.

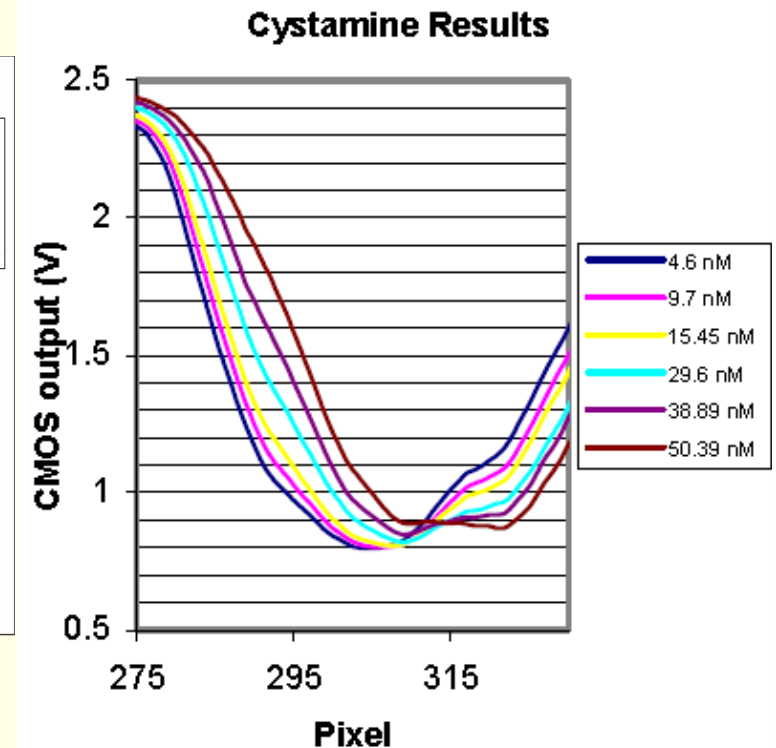
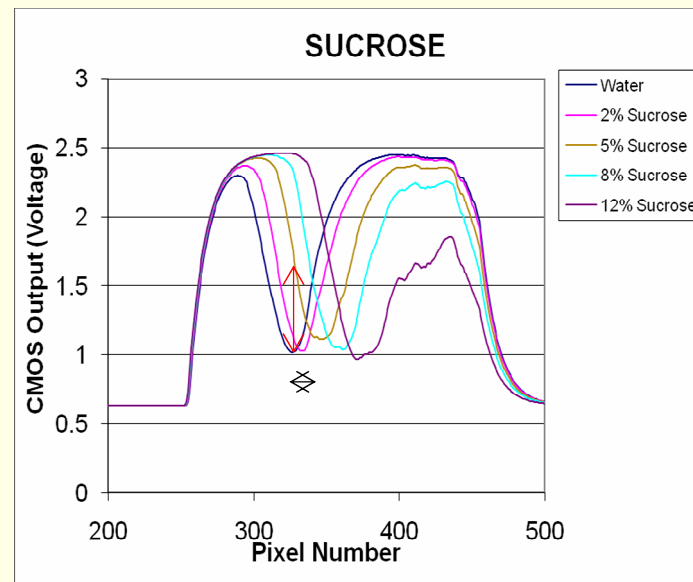


SPR System Development

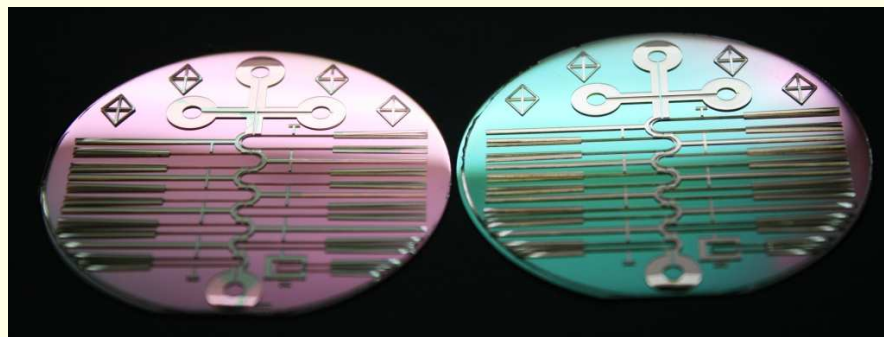
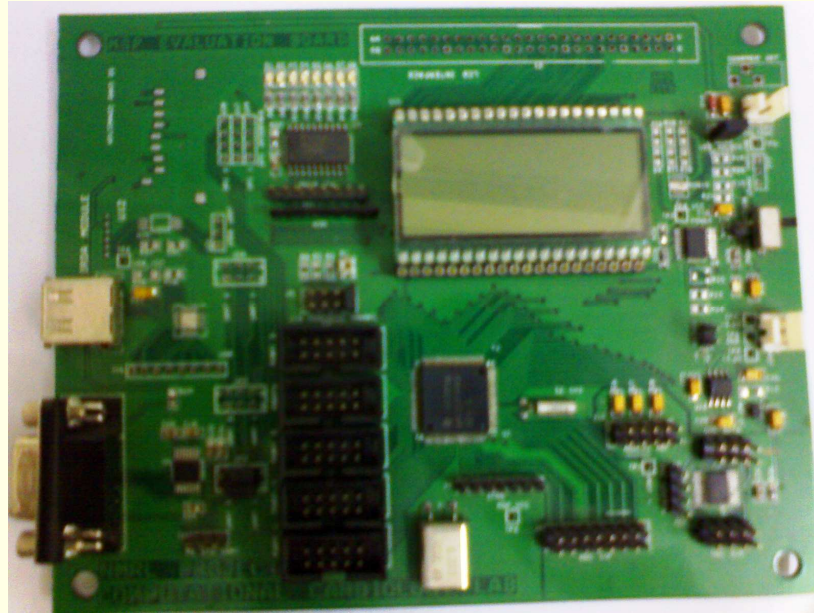
- Substrate Development
- Sensing System Development
- Software



water	1.33299
2%S	1.33587
5%S	1.34026
8%S	1.34477
12%S	1.35093



Development of Prototypes



Infrastructure @ IITB and Vision

- A state of the art microfabrication facility, better than any other university in Asia and most of the western countries as well.
- An atmosphere of multi-disciplinary research.
- A low cost device (<Rs 1 Lakh, i.e. \$2500).
 - Dusty, non ac-ed, electrically noisy, mechanically “unstable” environment. Preferably no moving parts.
- Multianalyte disposable cartridges (per test cost per analyte varying from Rs 5 to Rs 20).

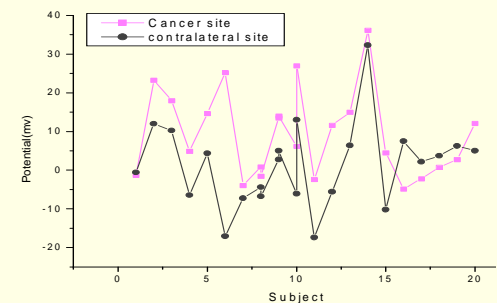
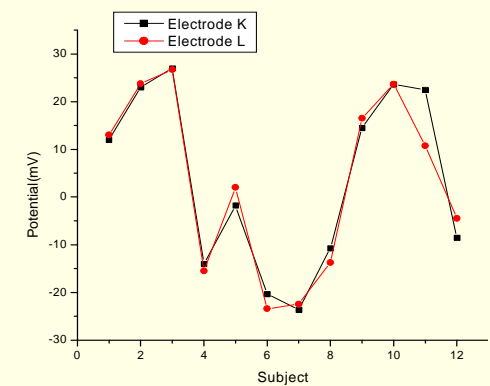
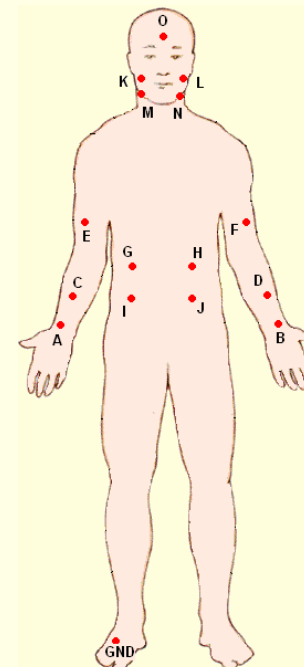
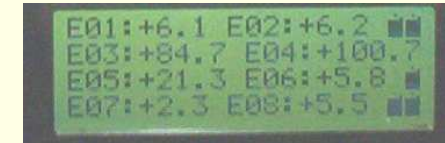
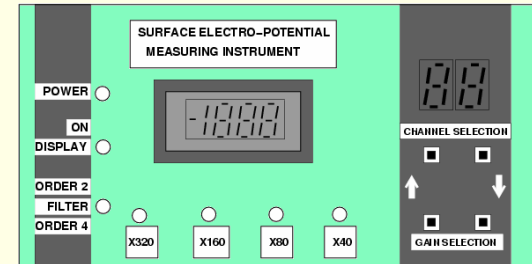
Surface Potentials and Cancer

Body surface electropotentials are affected by ionic imbalances brought about by proliferating (cancer) cells in underlying tissue.

This may be used for early detection of cancers and tumors (e.g. breast cancer) that occur near the surface.

A multichannel instrument to measure small DC potentials in an unshielded (noisy) environment.

Instrument operates on a 12V battery, thereby eliminating hazards of electrical shock.



At the 0.05 level, **the two means are significantly different**