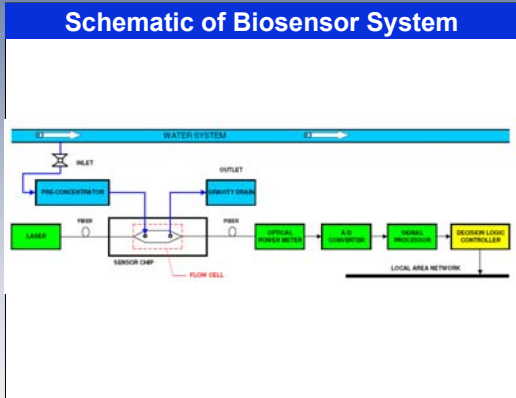


Integrated On-Chip Biological and Chemical Sensing

George Soliman, Shengling Deng, Joe Novak, Z. R. Huang

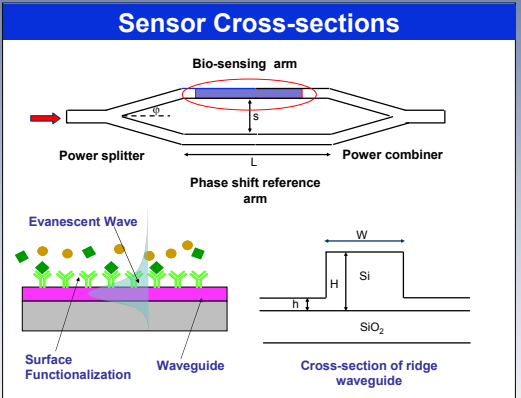
Electrical, Computer, and System Engineering Department, Rensselaer Polytechnic Institute, PI: Professor Z. Rena Huang, Industry Sponsor: O'Brien & Gere Inc.



Measurement Sensitivity

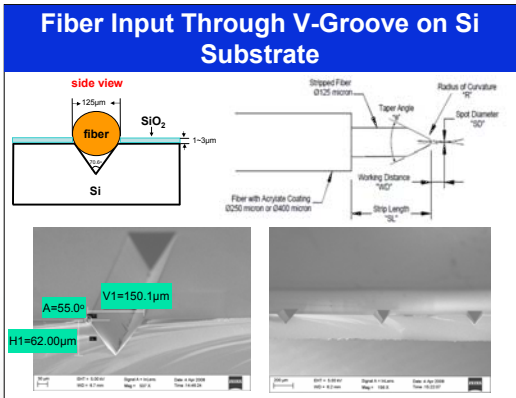
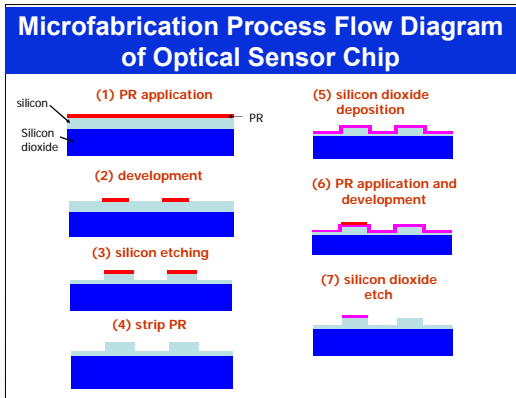
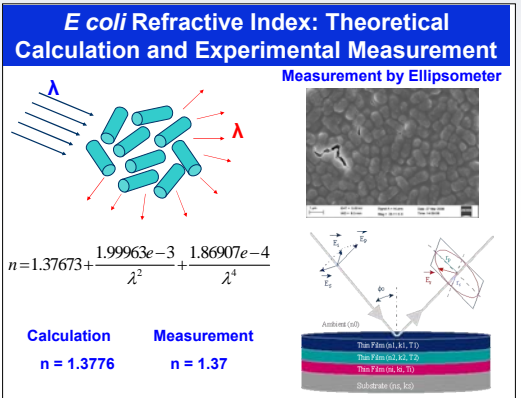
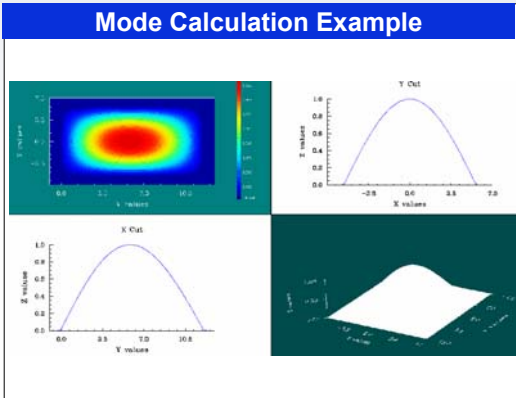
Sensing Principle	DL (pg/mm ²)
Surface Plasmon Resonance	2-5
Resonant mirror	5
Grating coupler	1-10
Mach-Zehnder interferometer	0.1
Young interferometer	0.7
Reflectometric interference spectroscopy	1-5

$$\Delta\phi = \frac{2\pi}{\lambda} L \Delta n_{eff} = 0.8\pi$$

$$\frac{I}{I_o} = \cos^2\left(\frac{\Delta\phi}{2}\right) \approx 9.5\%$$


Optical Field Confinement in Ridge Waveguide for Bio-Sensing

Concentration	Phase shift	Intensity reading (photodetector)
Low	0.2π	0.9mW
Medium	0.5π	0.5mW
High	0.8π	0.1mW



- ### Challenges of Fiber-to-Chip Alignment Through V-Groove
- Optimal distance between the fiber and the waveguide due to spot size mismatch
 - Fiber spot size around 3μm compared to Si waveguide height of about 300nm
 - Theoretical prediction v.s. experimental results
 - Fiber mechanical integrity during alignment and coupling
 - Develop an assembly procedure to ensure alignment accuracy according to calculated parameters.

