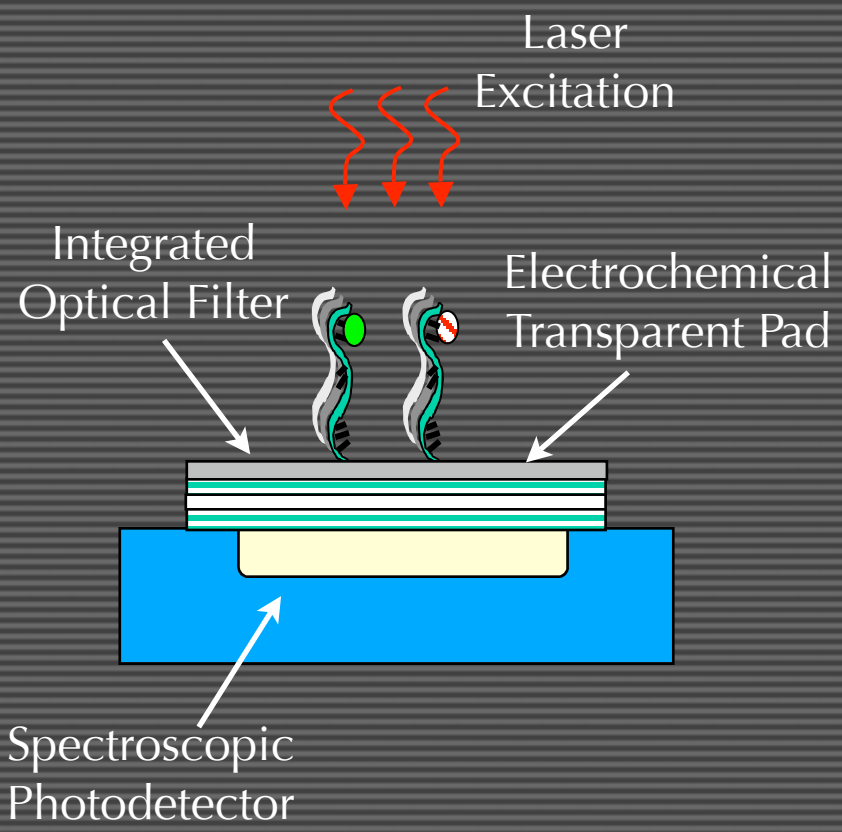
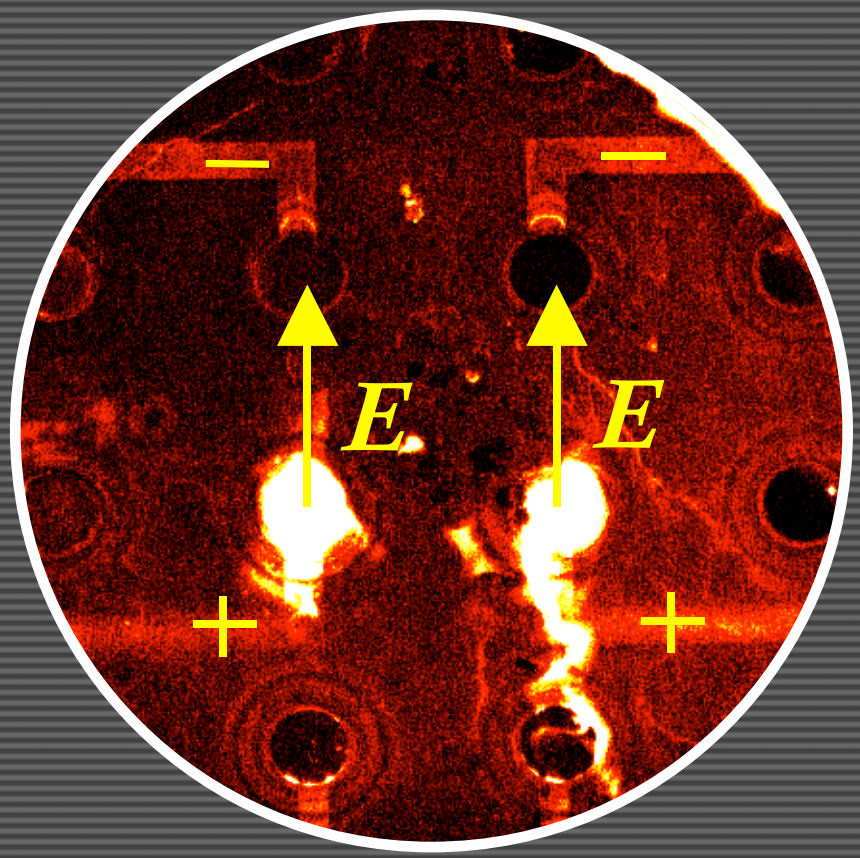
MultiSensor Fusion

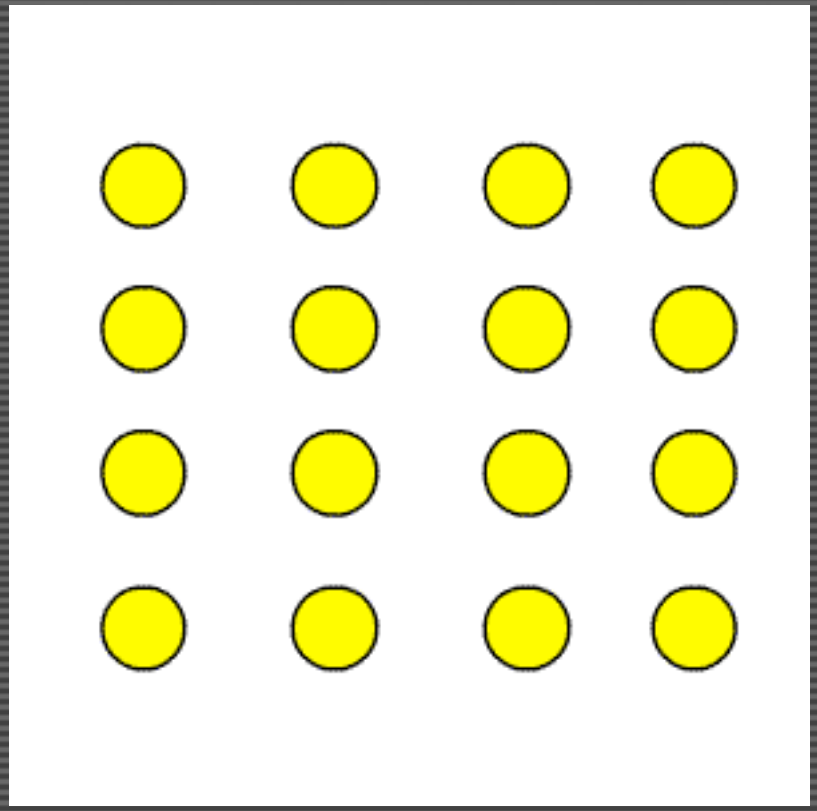
MultiSensor Fusion

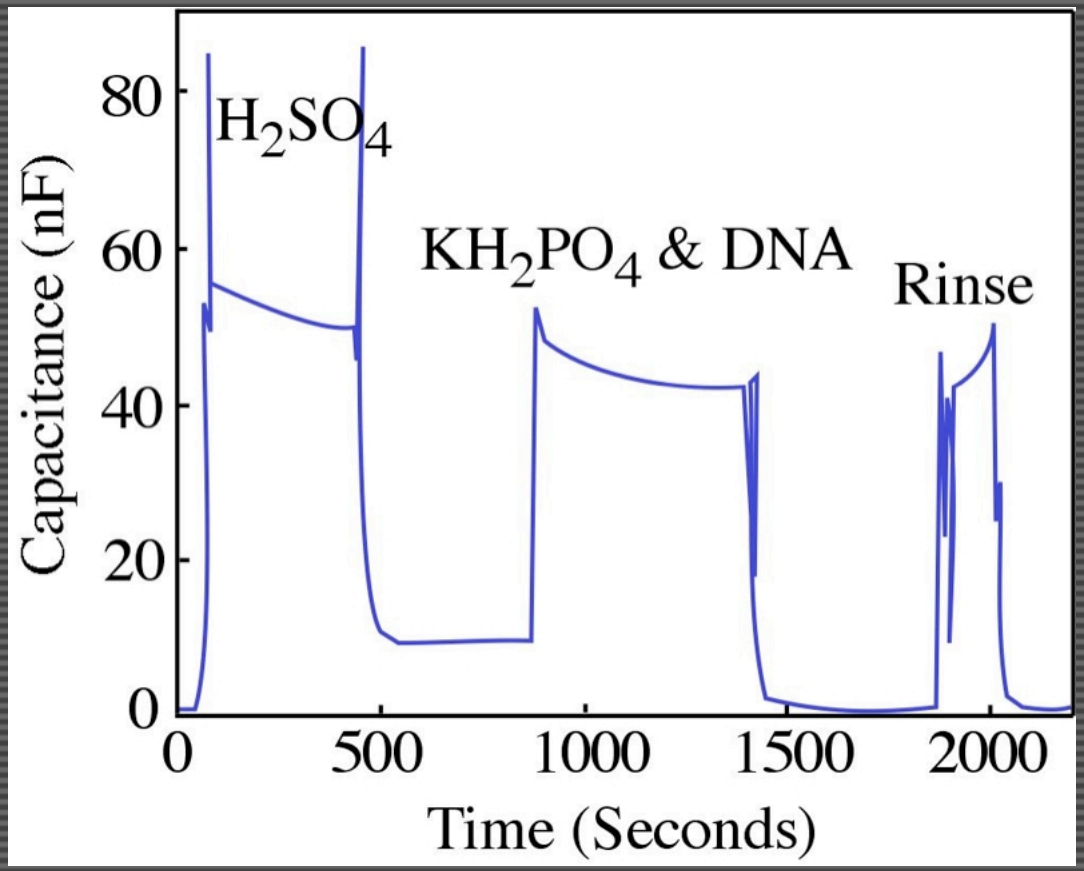
1. Electric Field Directed Binding
2. Hybridization Site Monitored with Capacitance
3. Electrochemical Analysis at Each Pad
4. On Chip Photodetectors
5. Data Transfer from Chip to Bioinformatics



Electric Field Assisted DNA



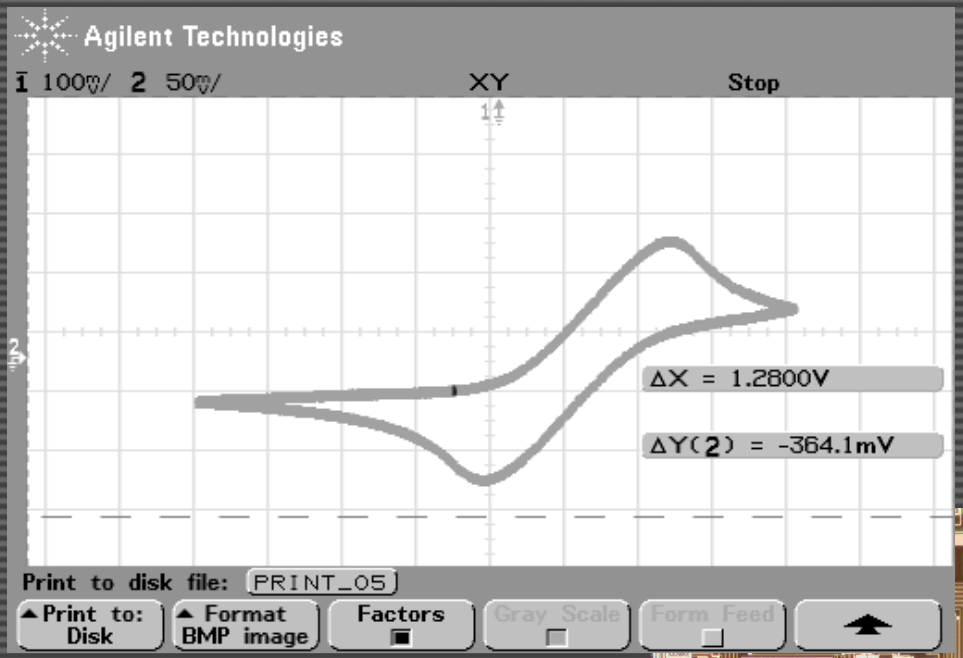


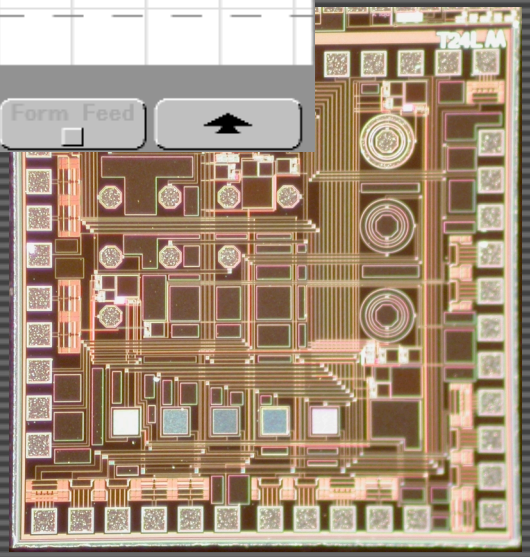


Pad Characterization

Cyclic Voltammetry

- On Chip Chemical Characterization
- Monitor Pad Coverage
- Determine Prehybridization Potential



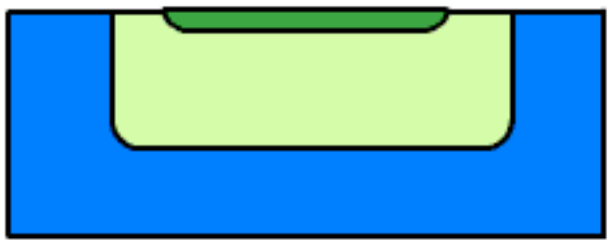


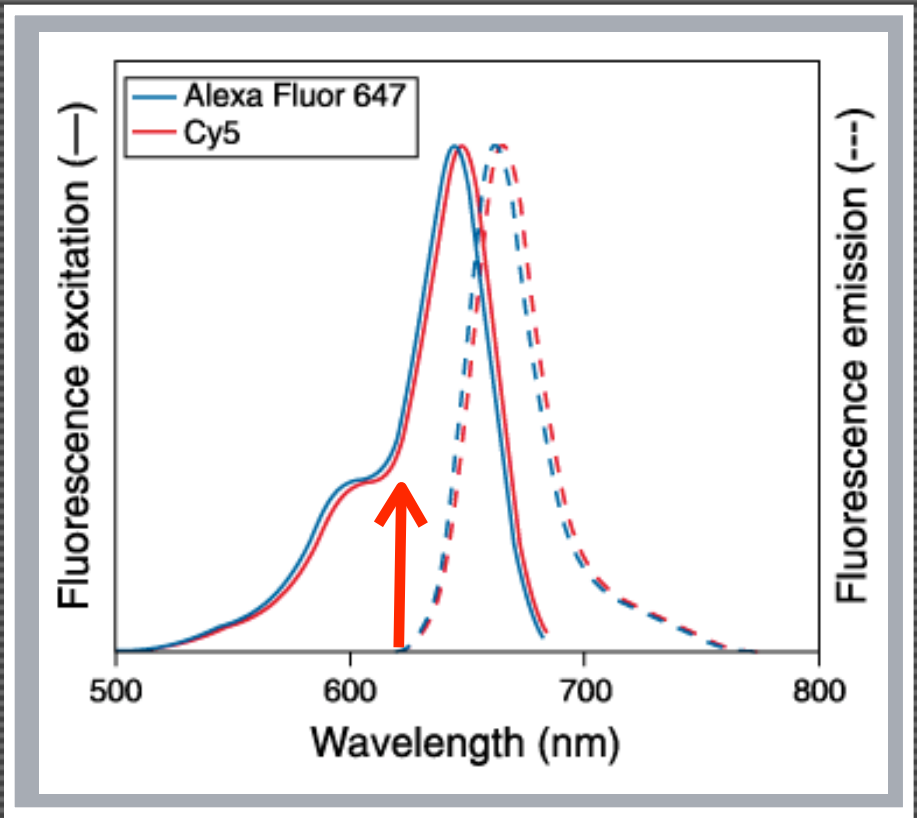
OPTI580 Microphotonics

CMOS Photodetector

Lambert's Law

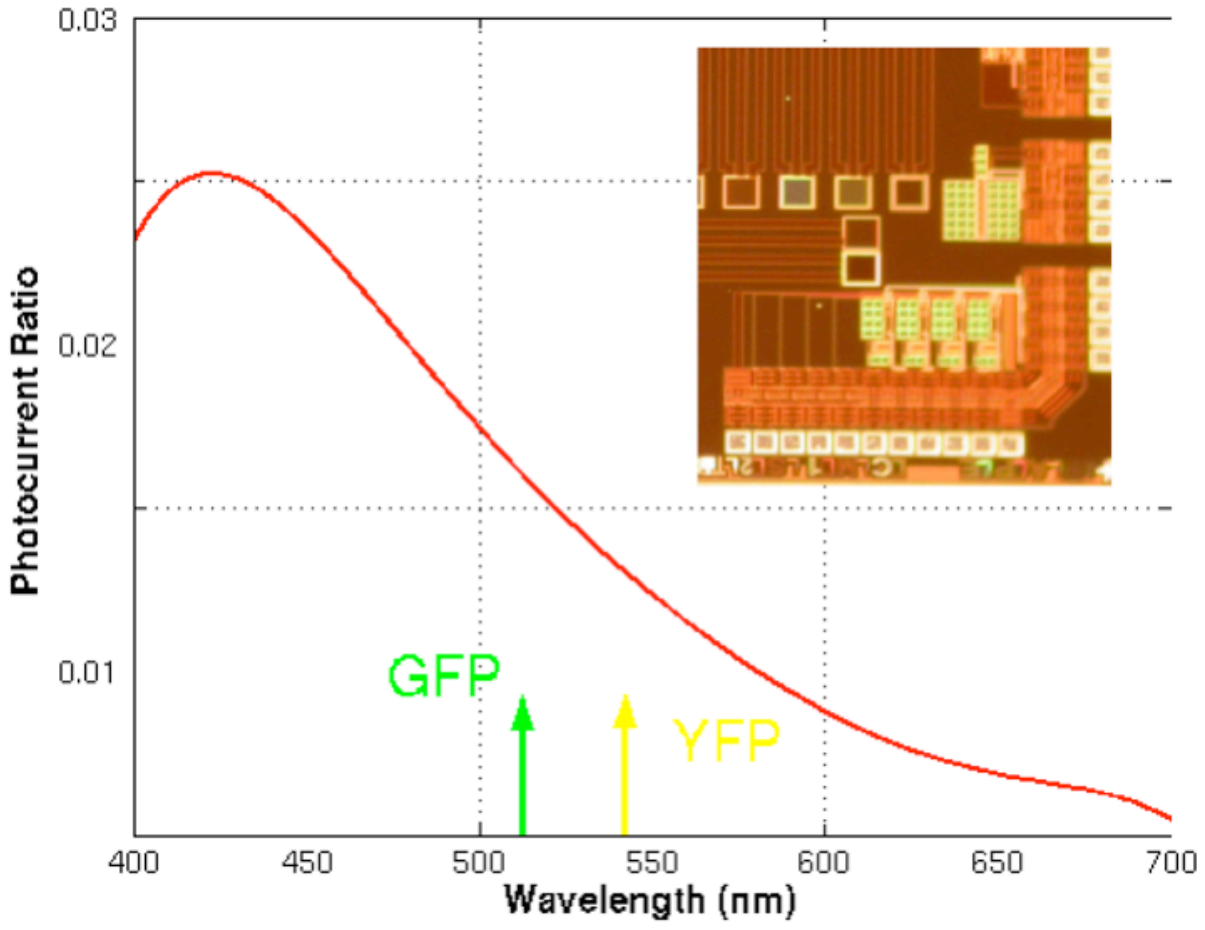
$$I = I_o e^{-\alpha x}$$



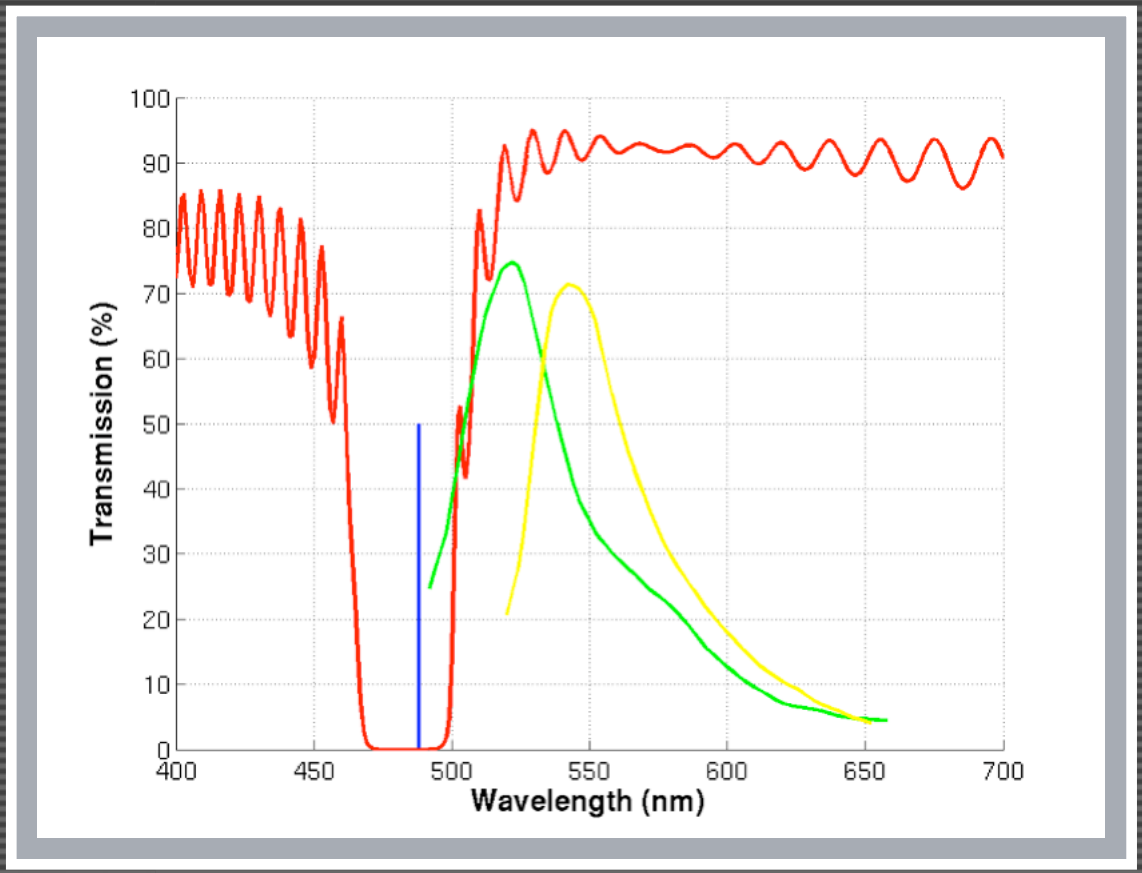


See Class Notes
OPTI580 Microphotonics
Instructor: D. L. Mathine

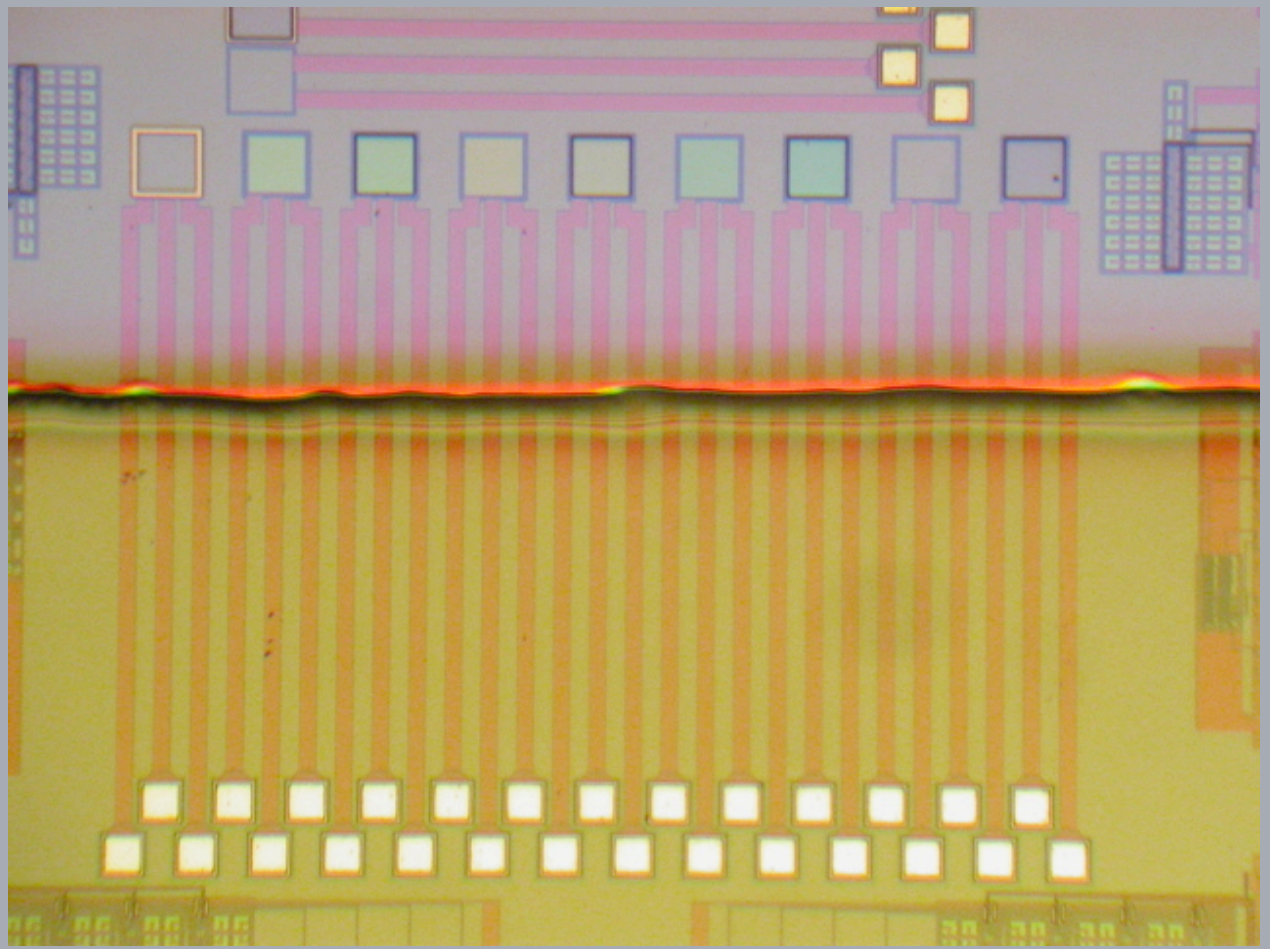
Spectroscopic Photodetectors



Optical Filter



Optical Filter Integration

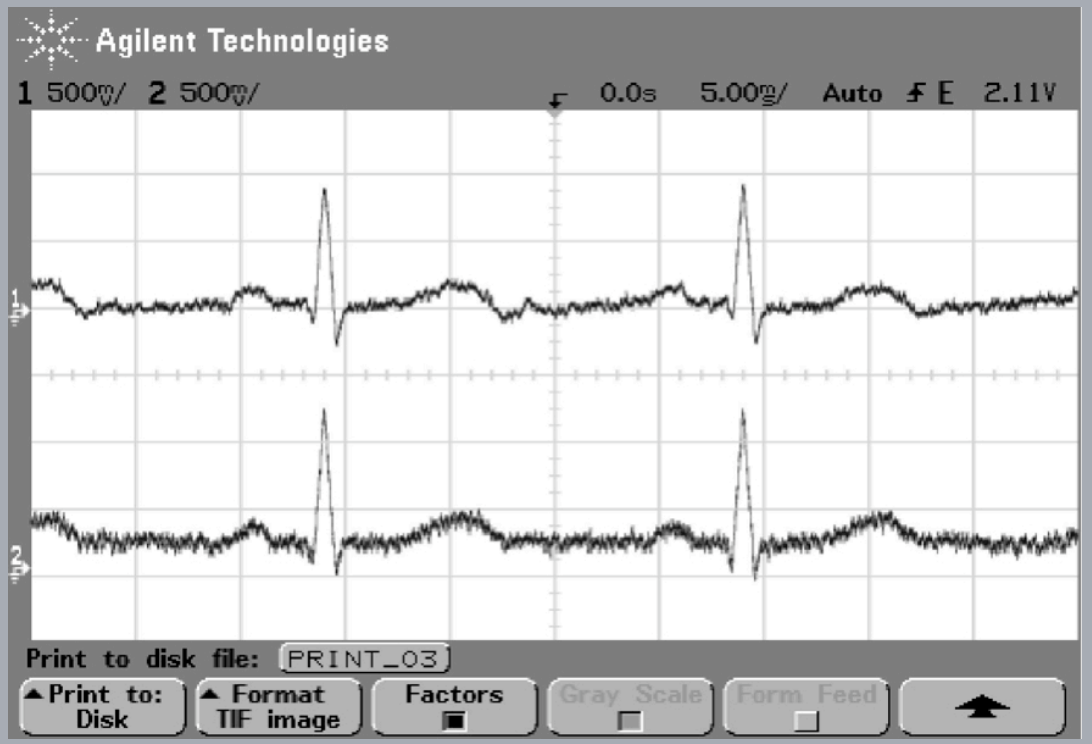


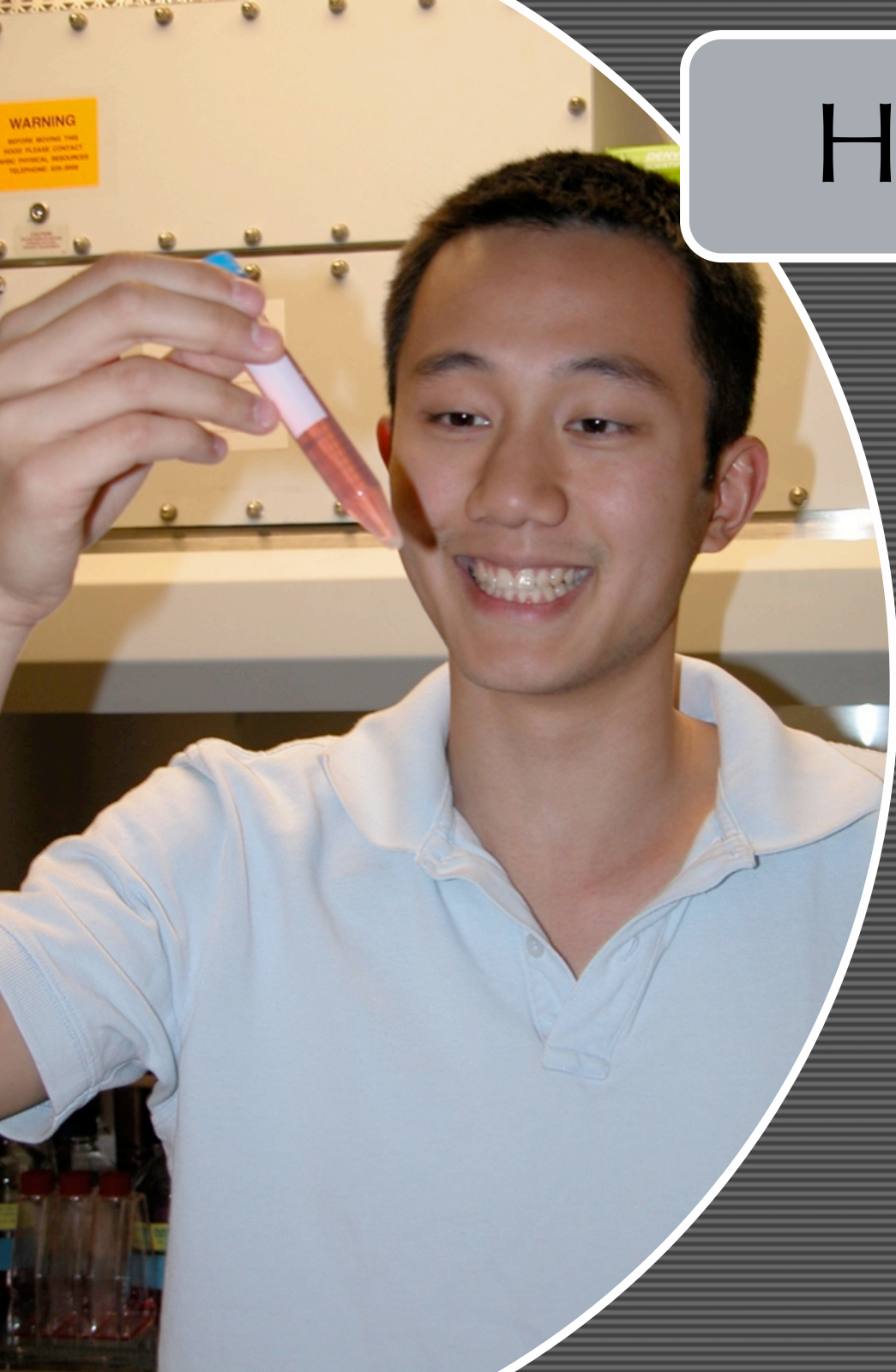
Cardiomyocytes

- Measure Action Potentials
- Electronic Circuit Design
- Real Time Monitor Cell Health

Abiotic Testing

- Upper curve filtered
- Lower curve unfiltered
- Filter from 150Hz to 25kHz





HL-1 Cell Growth

- Undergraduate Students
- Interdisciplinary
- Enhanced Biochamber Design

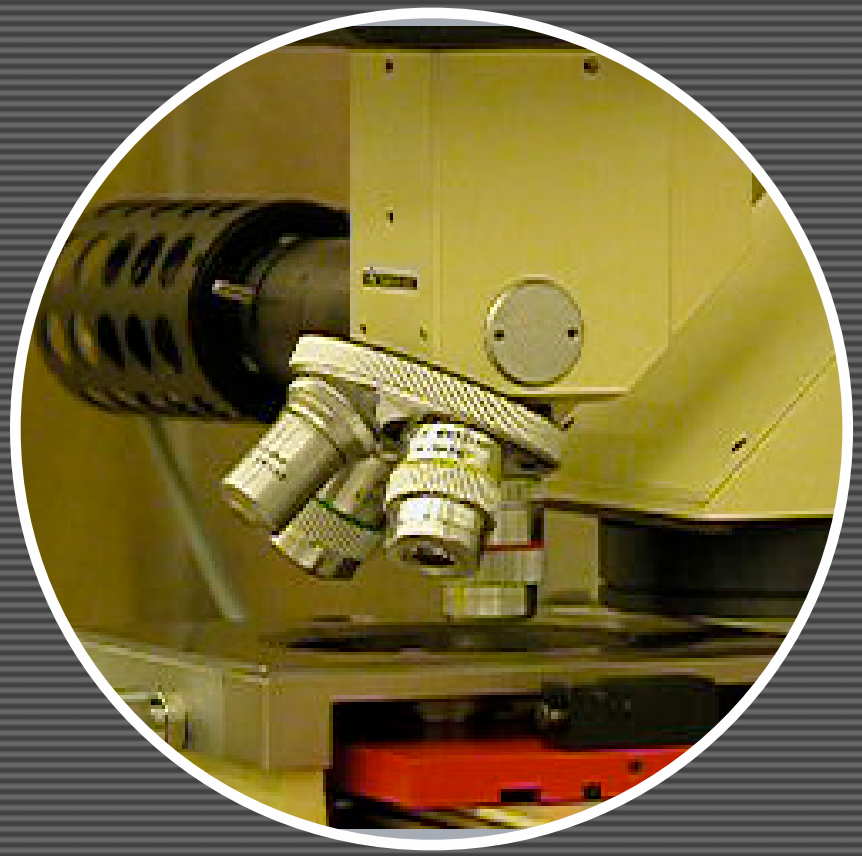
Microfabrication Techniques

Why CMOS ?

- Complementary Metal Oxide Semiconductor (CMOS)
- Replace “dumb” substrate with “smart” substrate capable of self interrogation
- Introduce electronic control of primary hybridizatuion and detection
- Couple advances in microelectronics with advances in microarrays

Microfabrication Methods

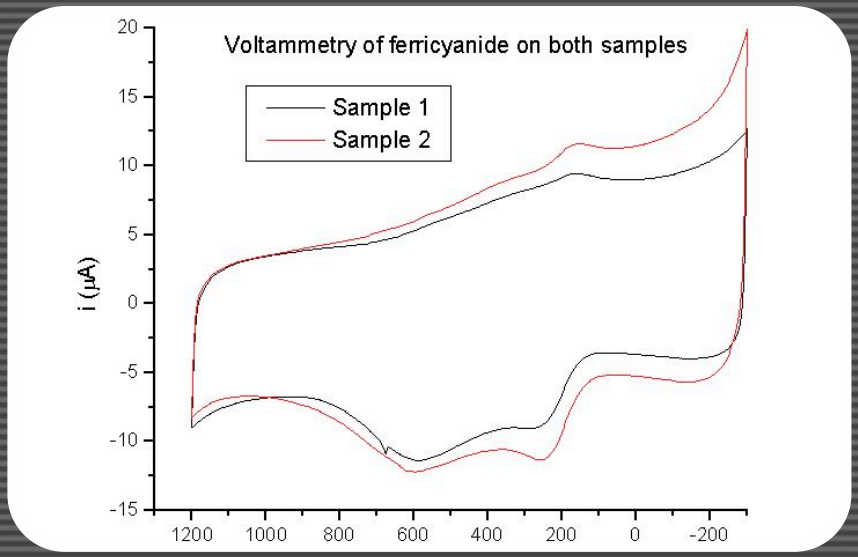
Photolithography
Reactive Ion Etching
Metalization
Ion Sputtering
Dielectric Deposition
BioMEMs



Indium Tin Oxide (ITO) Fabrication

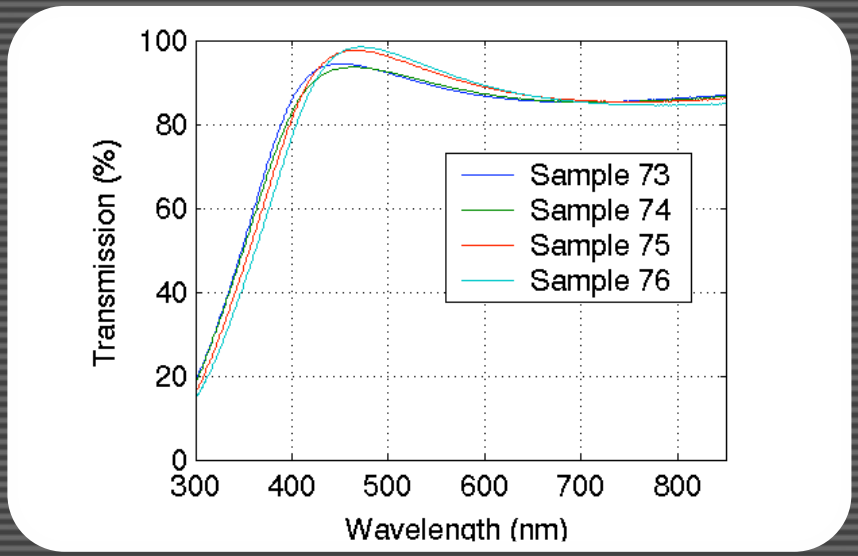
- Oxygen flow rate
  - Best results around 20 sccm
- Deposition rate
  - 28.6-33.3 Å/min
- Resistance values
  - Between 184 and 2×10^{7} Ω
- Vacuum anneal
  - 225^{o}C for 2 hours

ITO Characterization



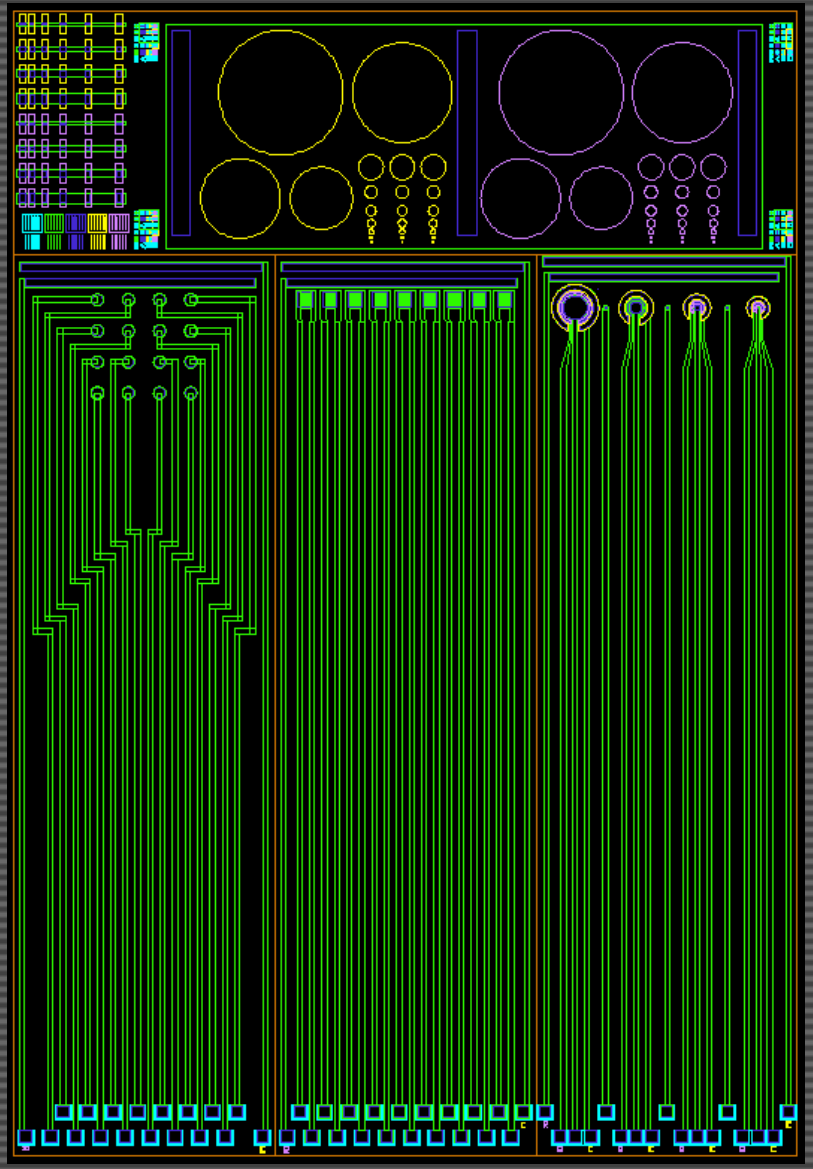
Approaches

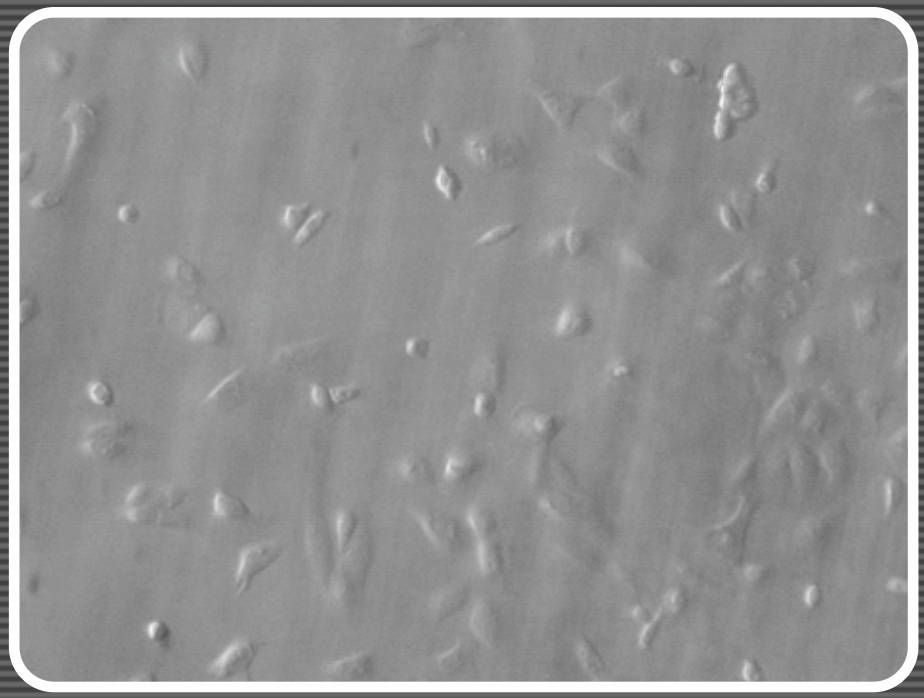
Cyclic Voltammetry
Optical Transmission
Conductivity



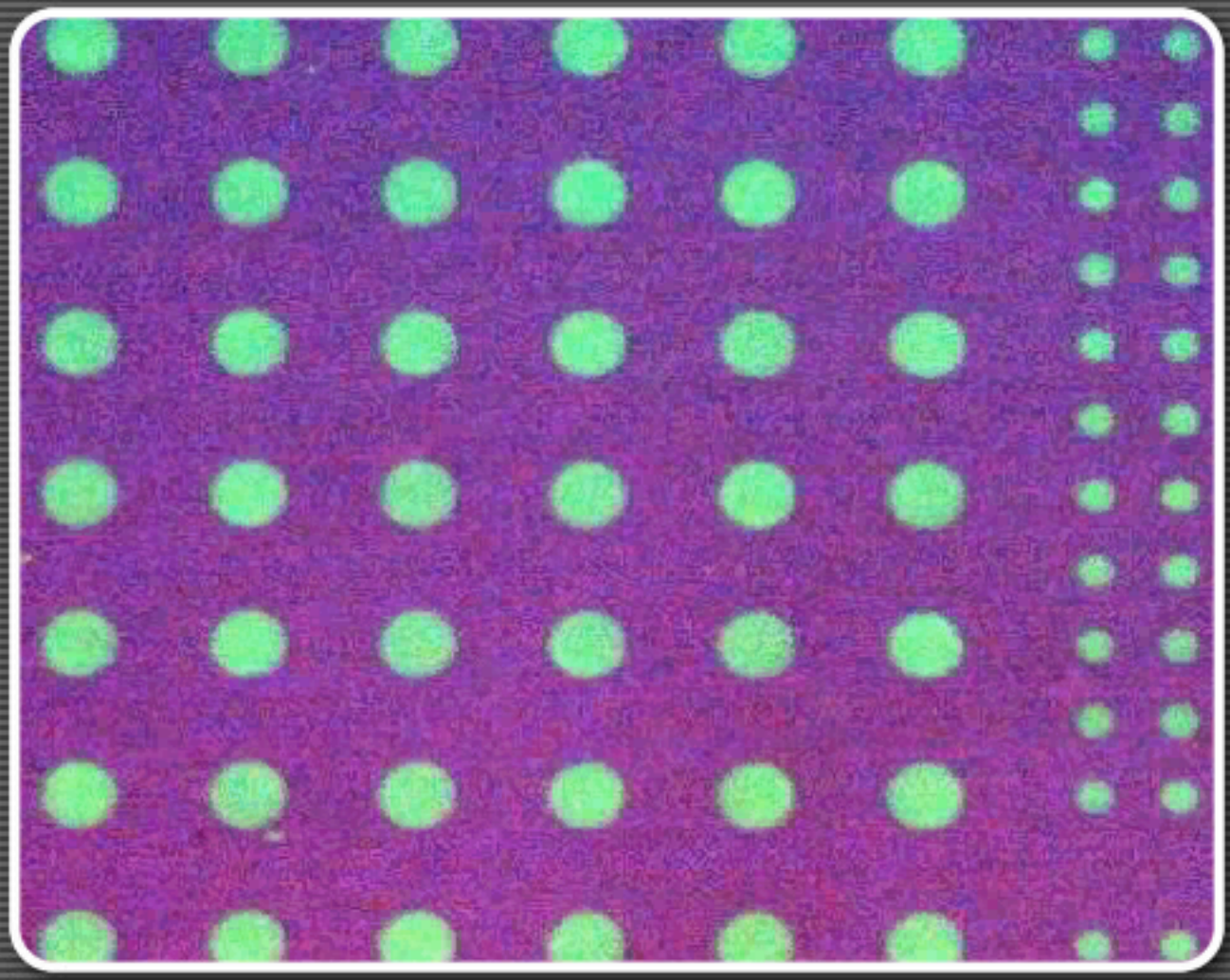
Test Chip Layout

- Capacitance Structures
- Process Evaluation
- Action Potential
- Cyclic Voltammetry



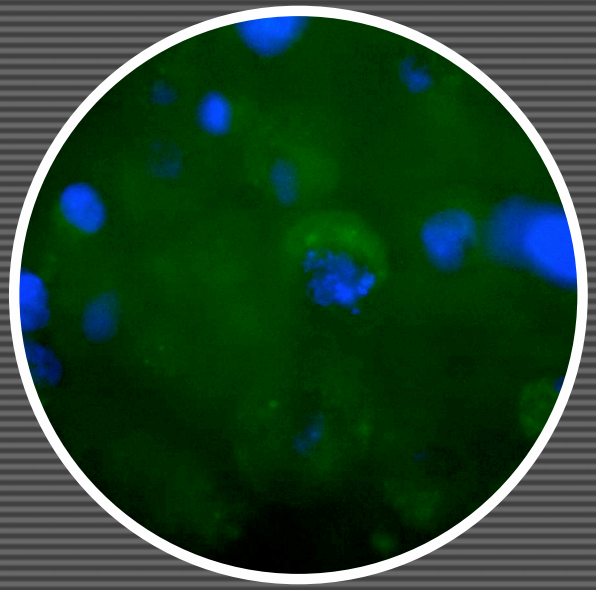


Cell Growth on Polylysine

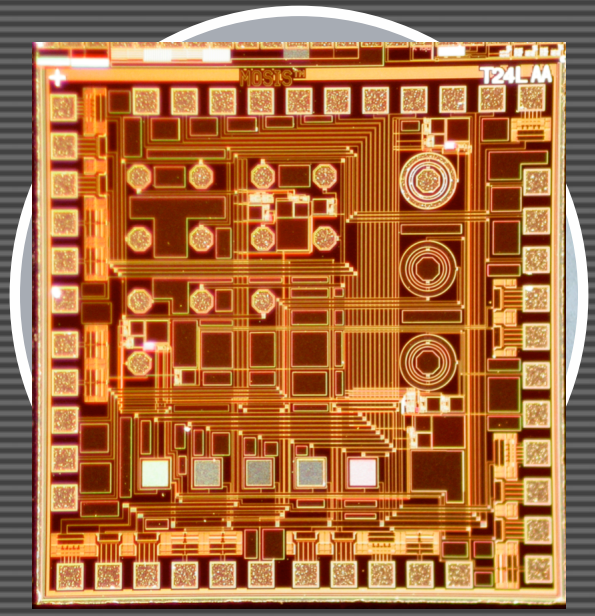


Patterning of Protein

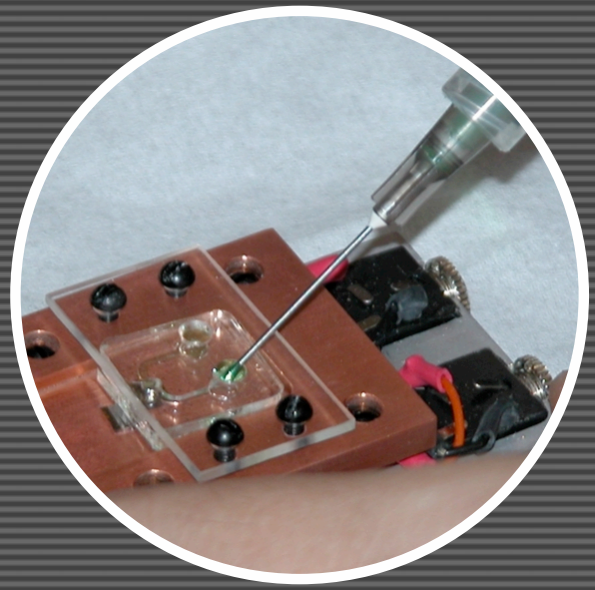
Summary



Cell-Based Biosensor



CMOS Sensor



Biochamber

That's All Folks!