

## Introduction

### Goal:

- Create an olfactory sensor prototype
- Measure electrical responses of Bovine Aortic Smooth Muscle Cells (BAOSMCs)

### Motivation:

- Understand biological process of odor detection
- Apply to biomedicine, environmental monitoring, and pharmaceutical screening

### Current Research:

- Prolong cell life outside of an incubator
- Improve hardware and software to measure action potentials of electrically active cells

## Prolonging Cell Life

### Membrane:

- Criteria for membrane material:
  - Hydrophobic
  - Biocompatible
  - Gas permeable

### Materials Tested:

- Paraffin oil
- Polydimethylsiloxane (PDMS)

### Sterile Water:

- Supplied continuously to cell culture

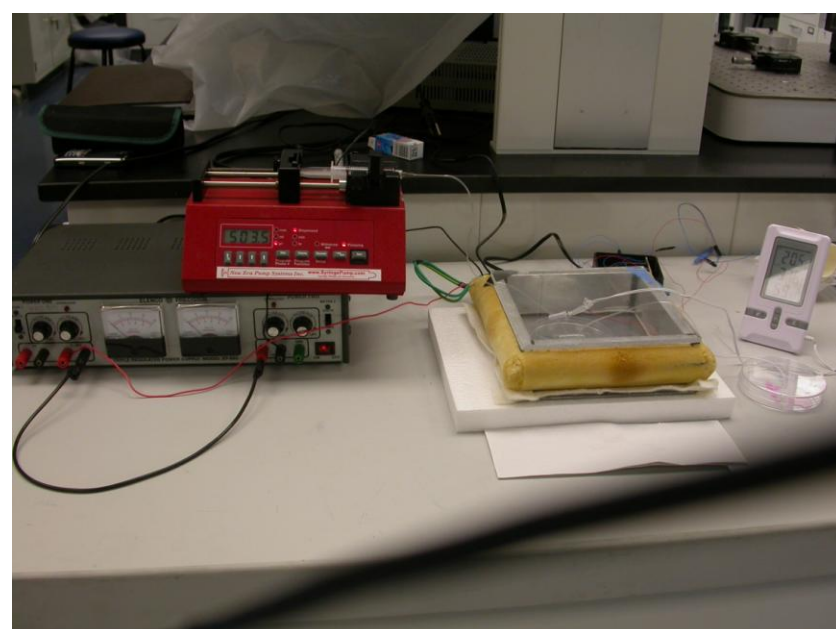
Place membrane over cell culture

Place cells in device which maintains 37°C

Measure evaporation of cell culture

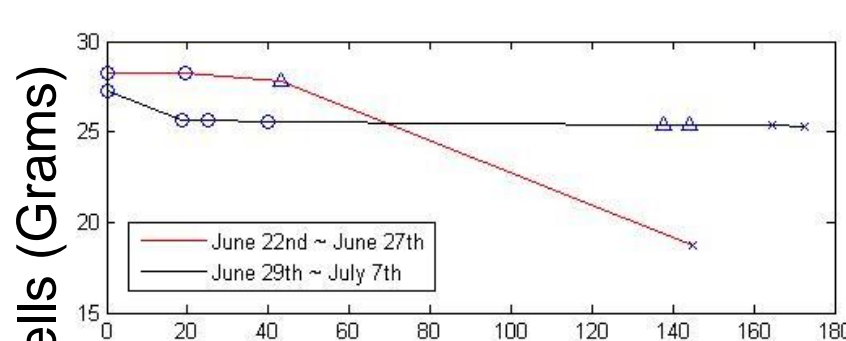
Observe viability of cells

Test permeability of membrane

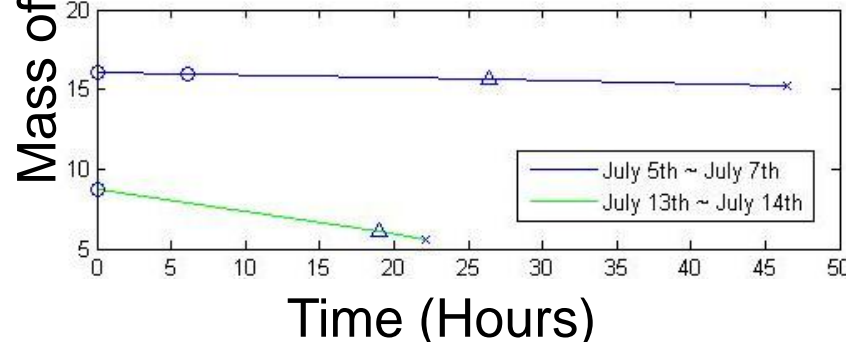


Experimental Set Up with Mini-Incubator (37°C)

### Paraffin Oil



### PDMS



- Markers indicate cell health
- Healthy △ Moderate ✕ Dead

Substance	Visible Penetration	
	Paraffin Oil	PDMS
0.2 M HCl	YES	NO
Geraniol	YES	NO
Eucalyptol	YES	NO
Pinene	YES	NO
Linalool	YES	NO

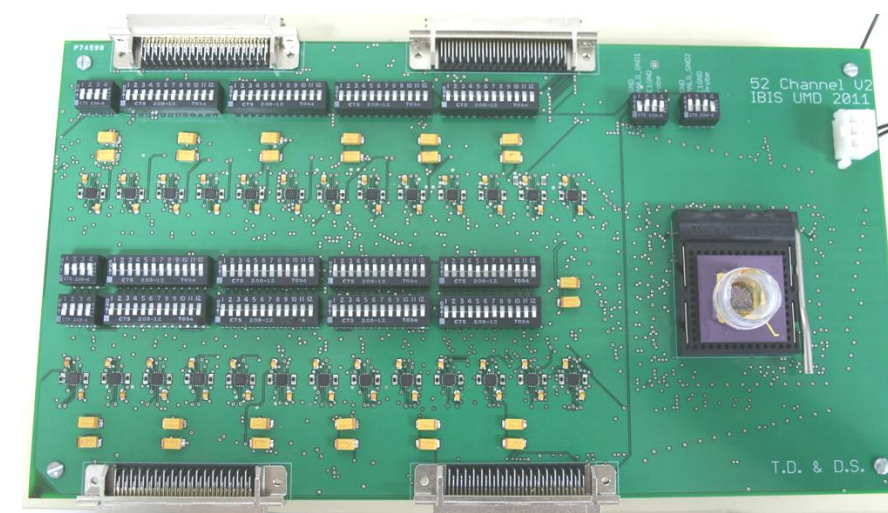
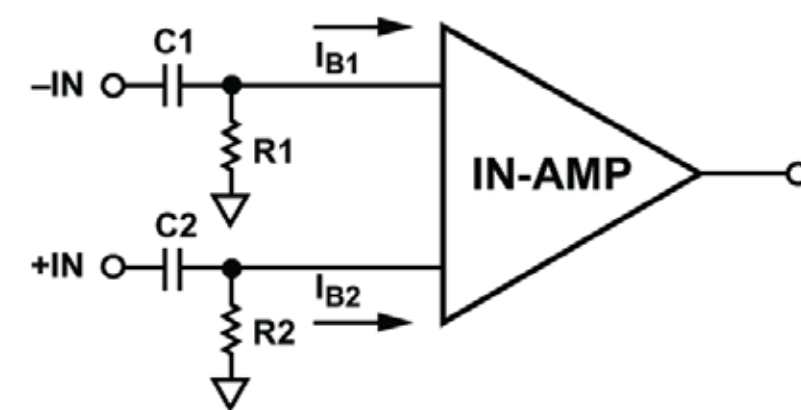
Table 1: Comparison of Permeability

- Only HCl induced pH change
- Both paraffin oil & PDMS are permeable to CO<sub>2</sub>

## Improving Instrumentation

### Hardware - Printed Circuit Board (PCB):

- 52 Channel Microelectrode Array
- 52 Instrumentation Amplifiers
- National Instruments Data Acquisition System

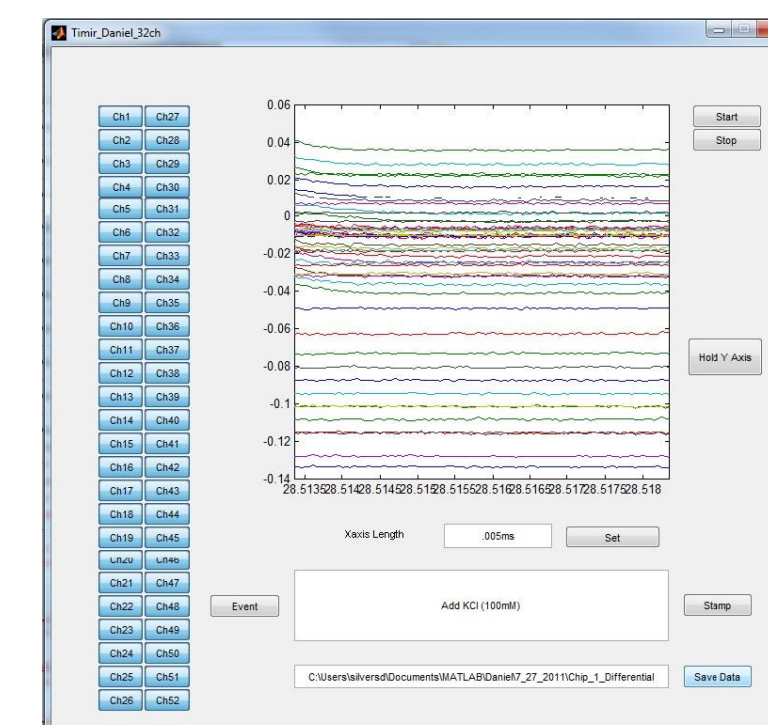


### Improvements:

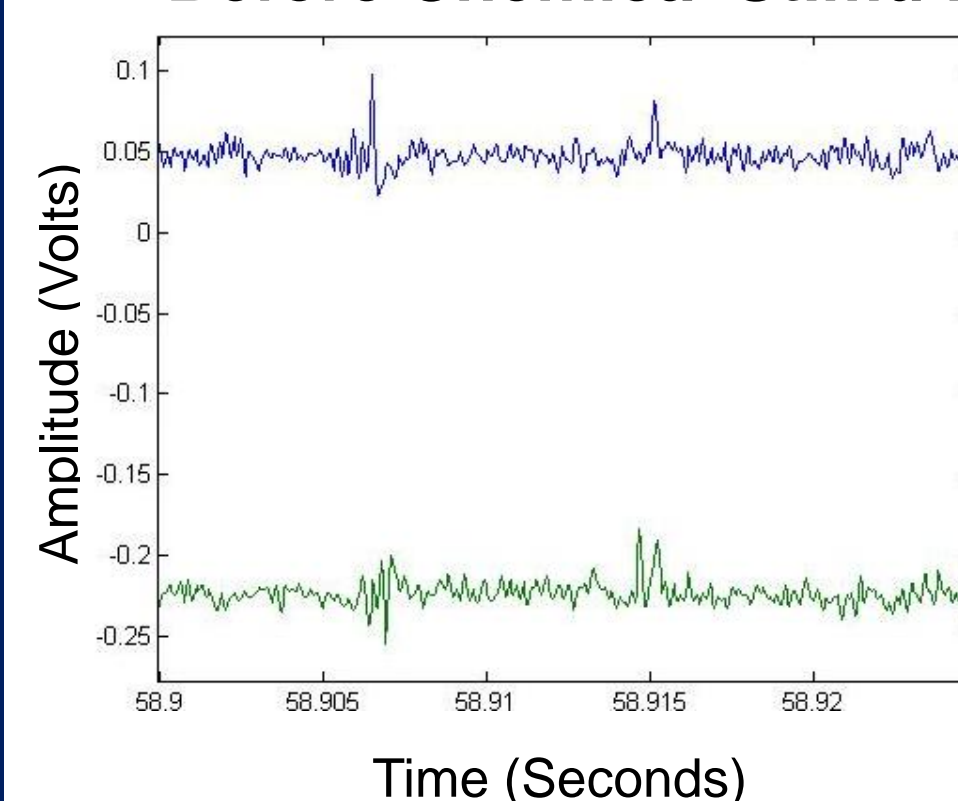
- Noise Reduction
- DIP switches
- Shielding
- Return Path to Ground

### Software – MATLAB GUI:

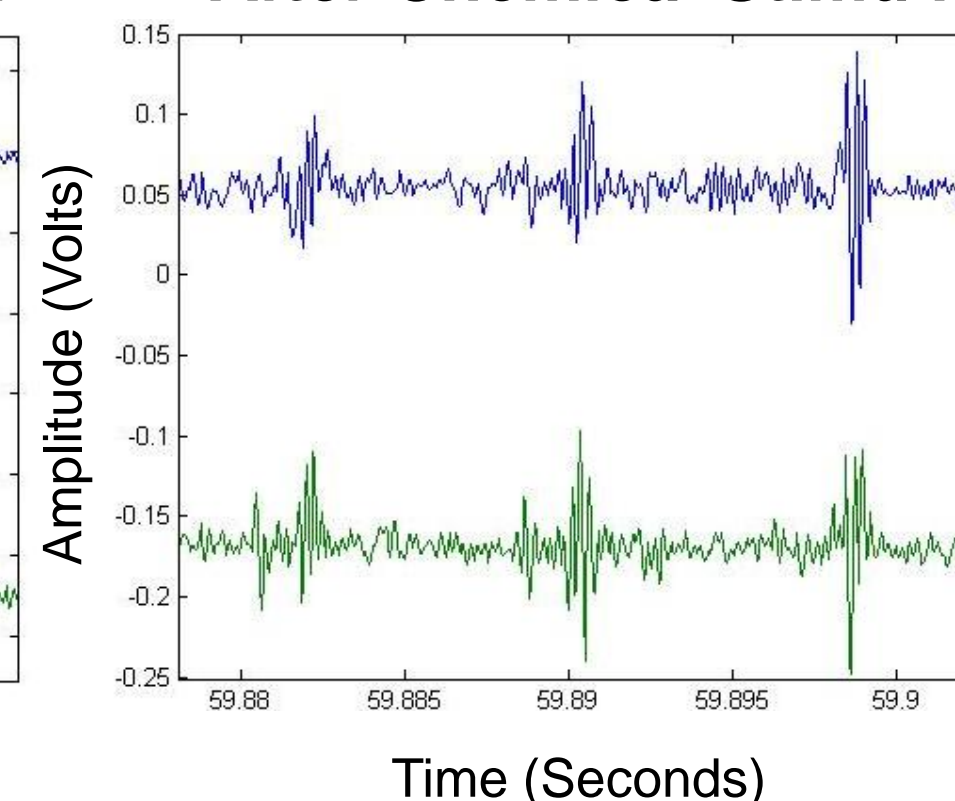
- Plots and stores incoming data
- Stamps time of experimental change
- Filters and displays relevant data



### Before Chemical Stimuli



### After Chemical Stimuli



- BAOSMC signals before and after introducing 100 mM KCl

## Conclusions

### Prolonging Cell Life:

- Paraffin oil & PDMS membranes maintained cell viability
- Sterile water supply failed to keep cells alive
- Selected compounds permeated only paraffin oil

### Improving Instrumentation:

- Spontaneous activity detected before chemical stimulation
- Enhanced electrical activity observed upon chemical stimulation
- Improved PCB successfully measured BAOSMC action potentials

## Future Work

### Olfactory Sensory Neurons:

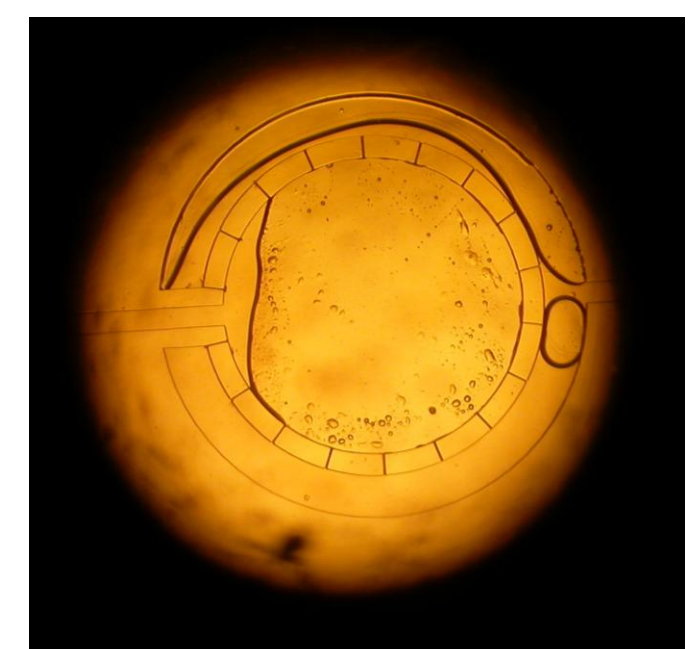
- Measure action potentials
- Introduce artificial mucus membrane
- Classify odors

### Imaging:

- Calcium ion dyes
- Voltage sensitive dyes

### Testing Chamber:

- Microfluidic device
- Introduce odors as vapors



Cells plated in a microfluidic device

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