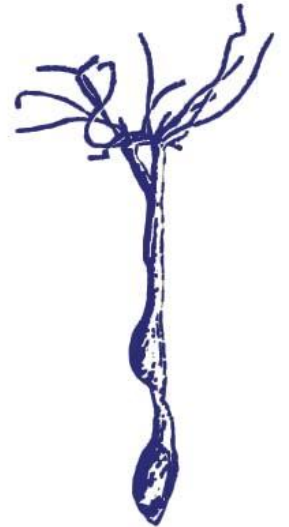




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Nose on a Chip

Hetal Patel & Daniel Silversmith
Faculty Mentor: Dr. Pamela Abshire
Graduate Student Mentor: Timir Datta





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Purpose

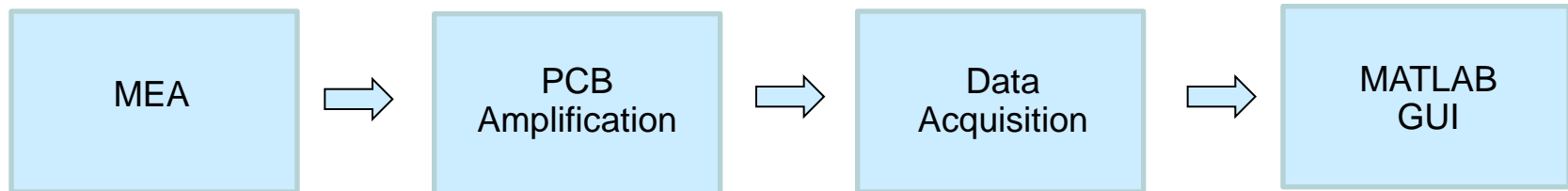
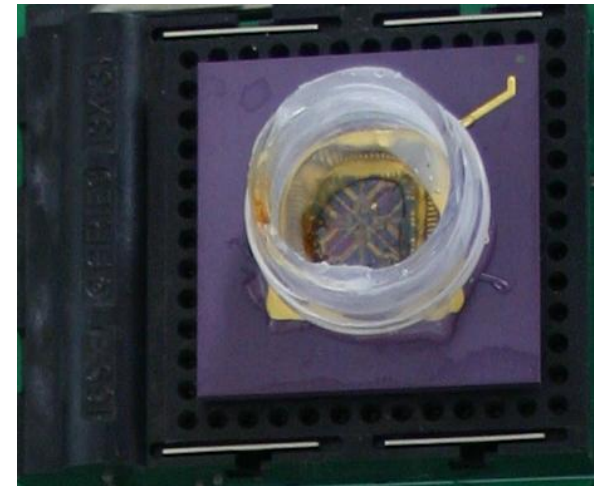
- To create a prototype olfactory sensor
- Applications:
 - Biomedicine
 - Environmental monitoring
 - Pharmaceutical screening
- Current Progress:
 - Improving instrumentation
 - Prolonging cell life



http://www.odt.co.nz/files/story/2009/05/drug_dog_murphy_shows_how_he_would_carry_out_a_dru_1923108146.JPG

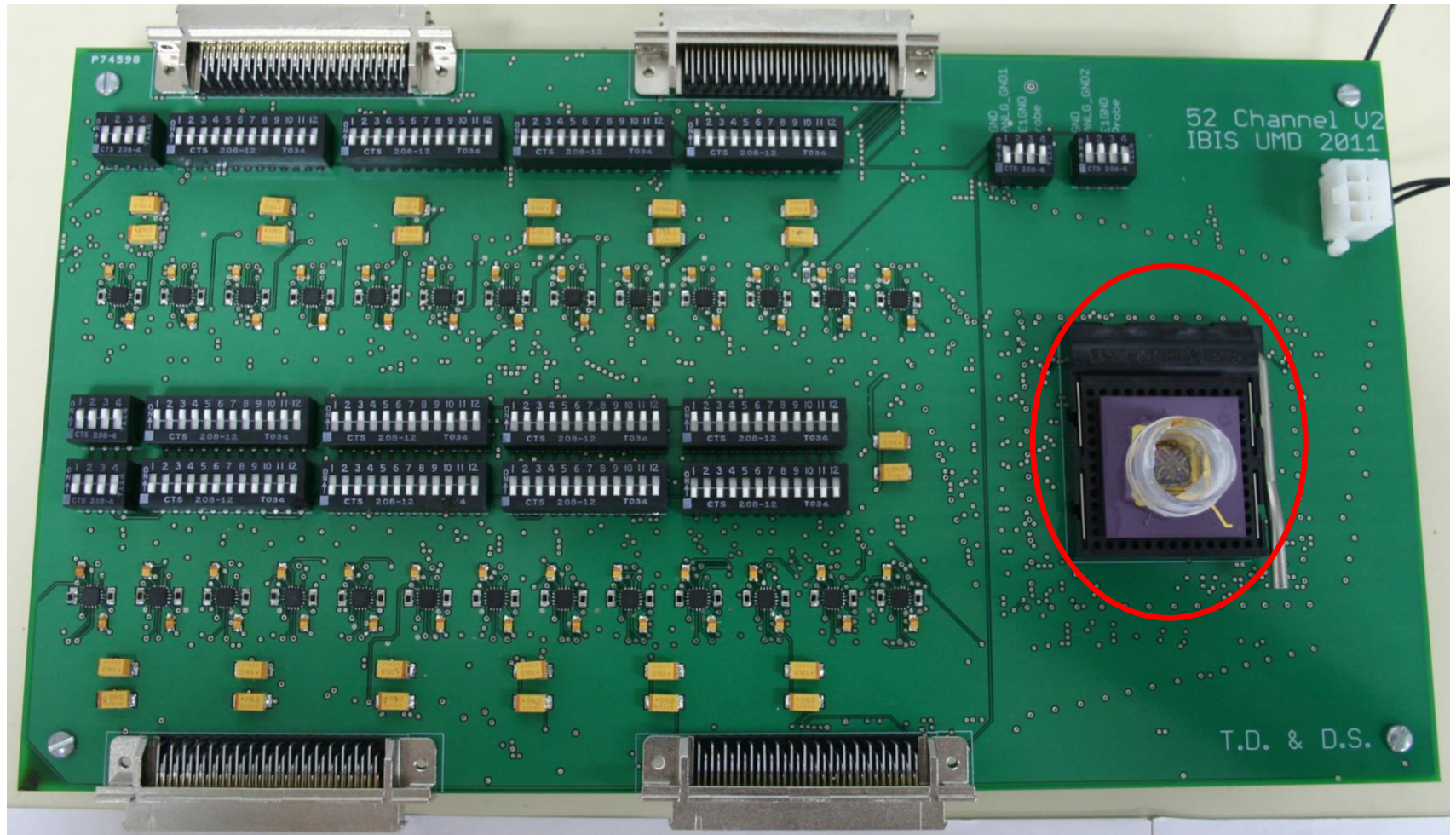
Approach

- Printed circuit board (PCB)
 - 52 channel microelectrode array
- Improving instrumentation
 - Sources of noise
 - Return path to ground
 - Data acquisition



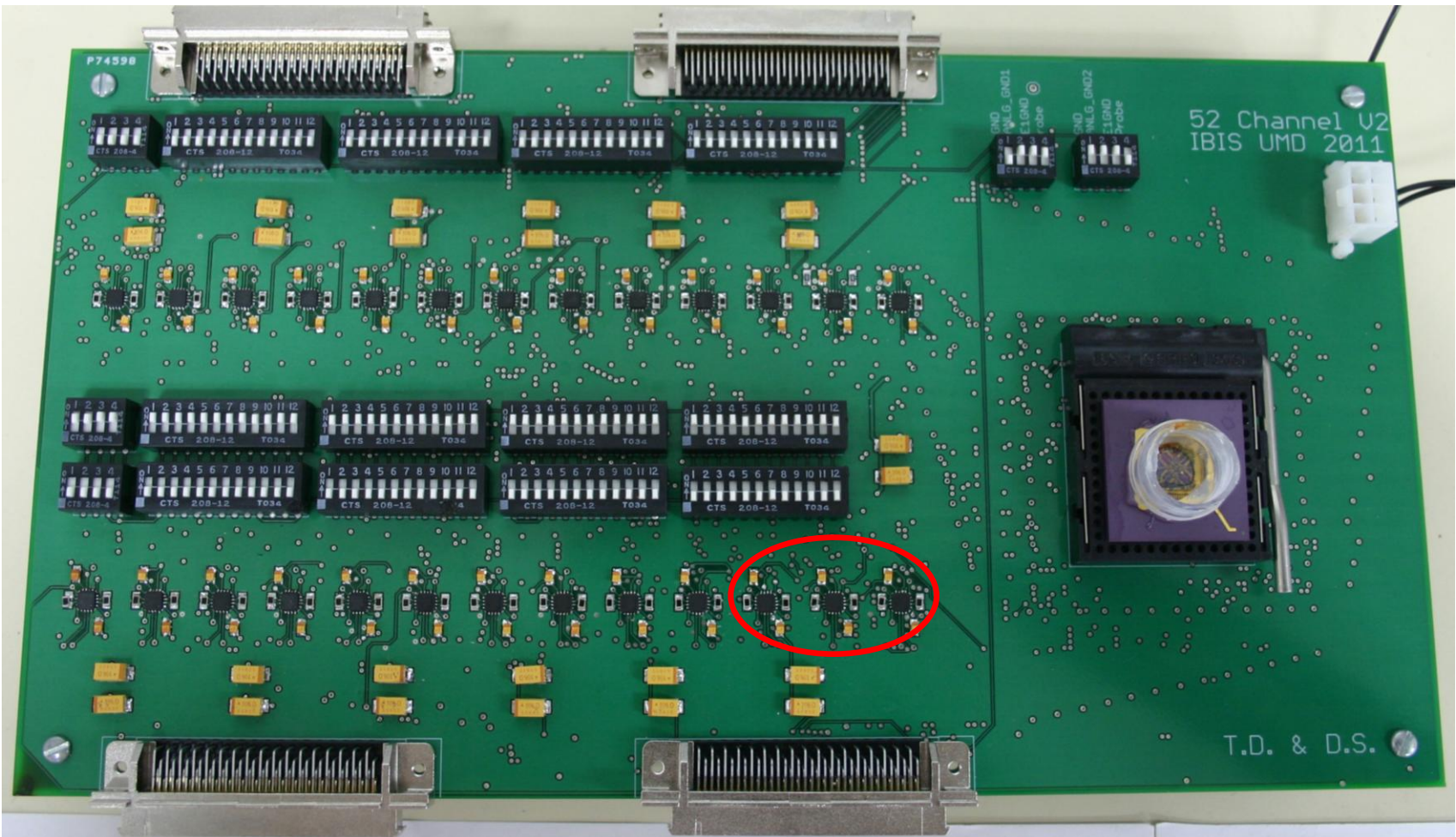
Current Progress: PCB

- 52 Channel Microelectrode Array



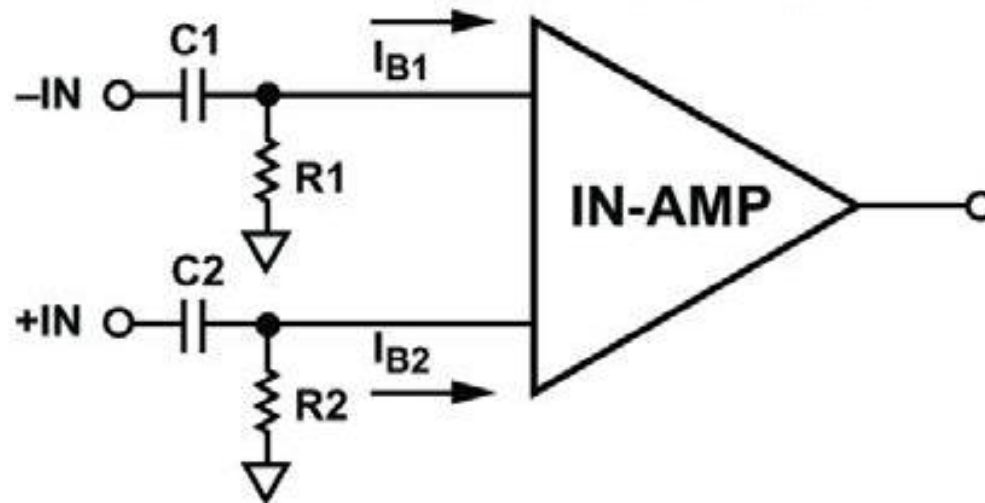
Current Progress: PCB

- 52 Instrumentation Amplifiers



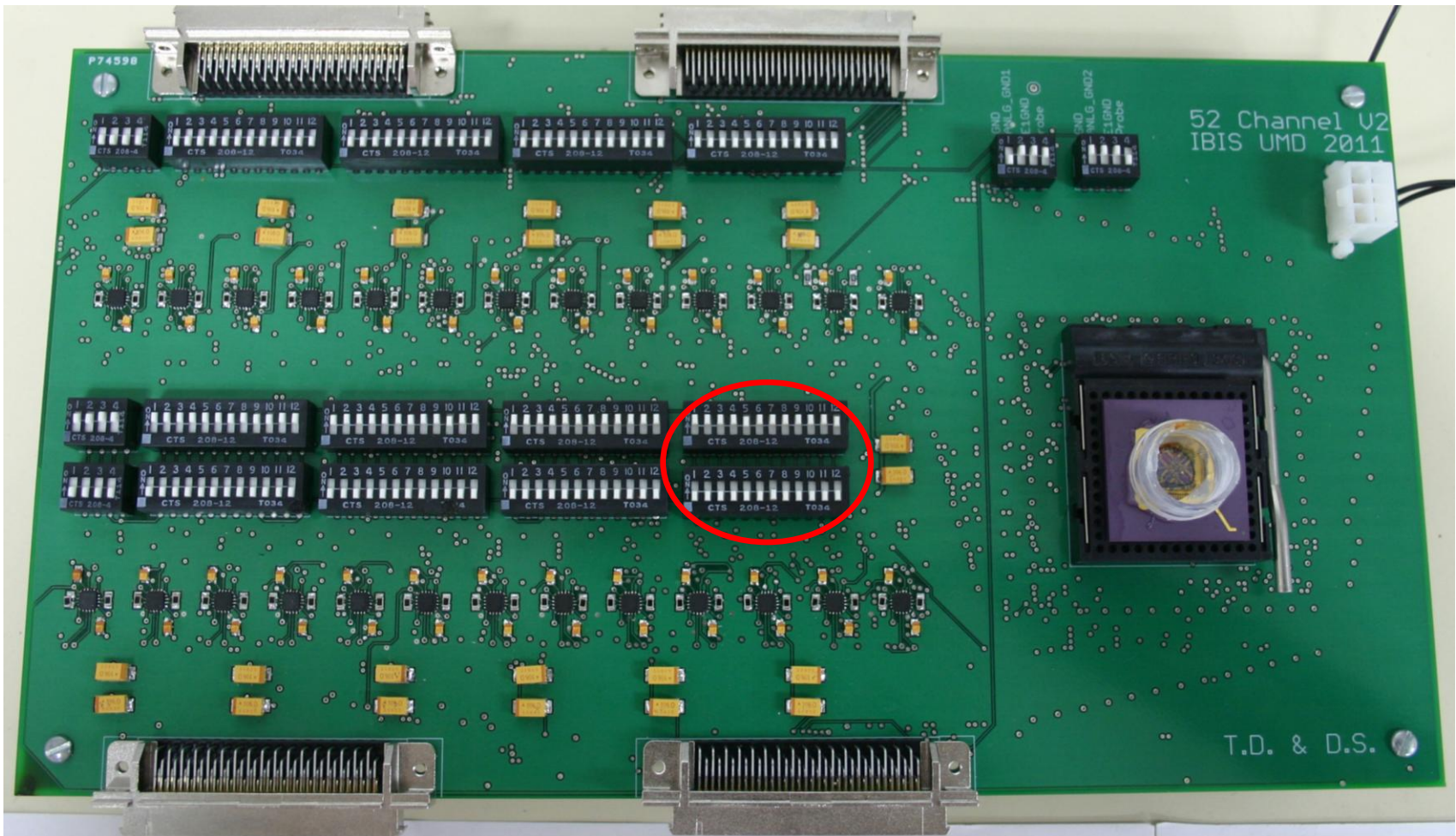
- Instrumentation Amplifier

- Gain of 100 V/V
- Inputs are capacitively coupled
- Return path to ground
- Positive input comes from an electrode
- Negative input comes from either ground or a neighboring electrode



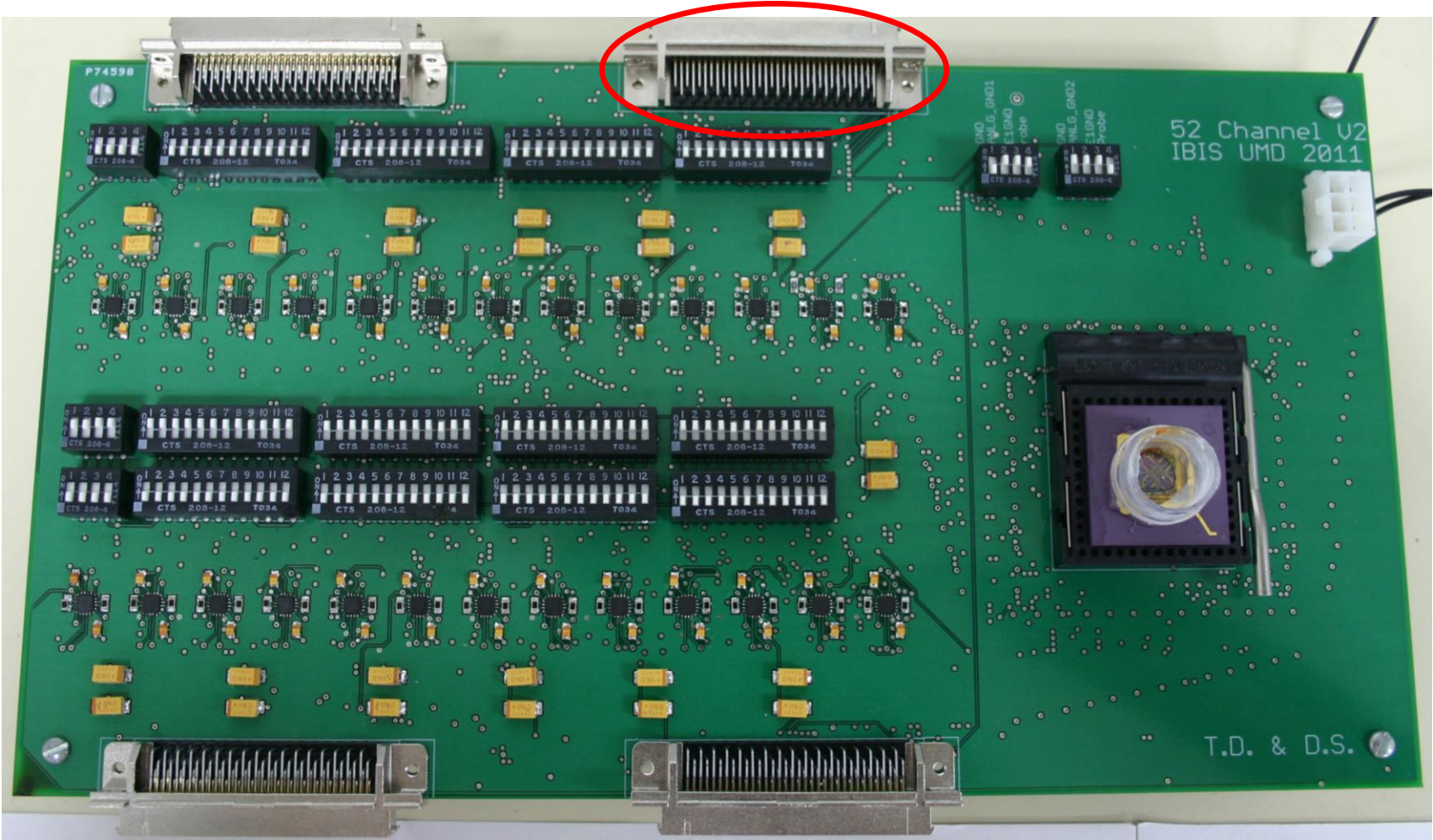
Current Progress: PCB

- Middle Array of DIP Switches



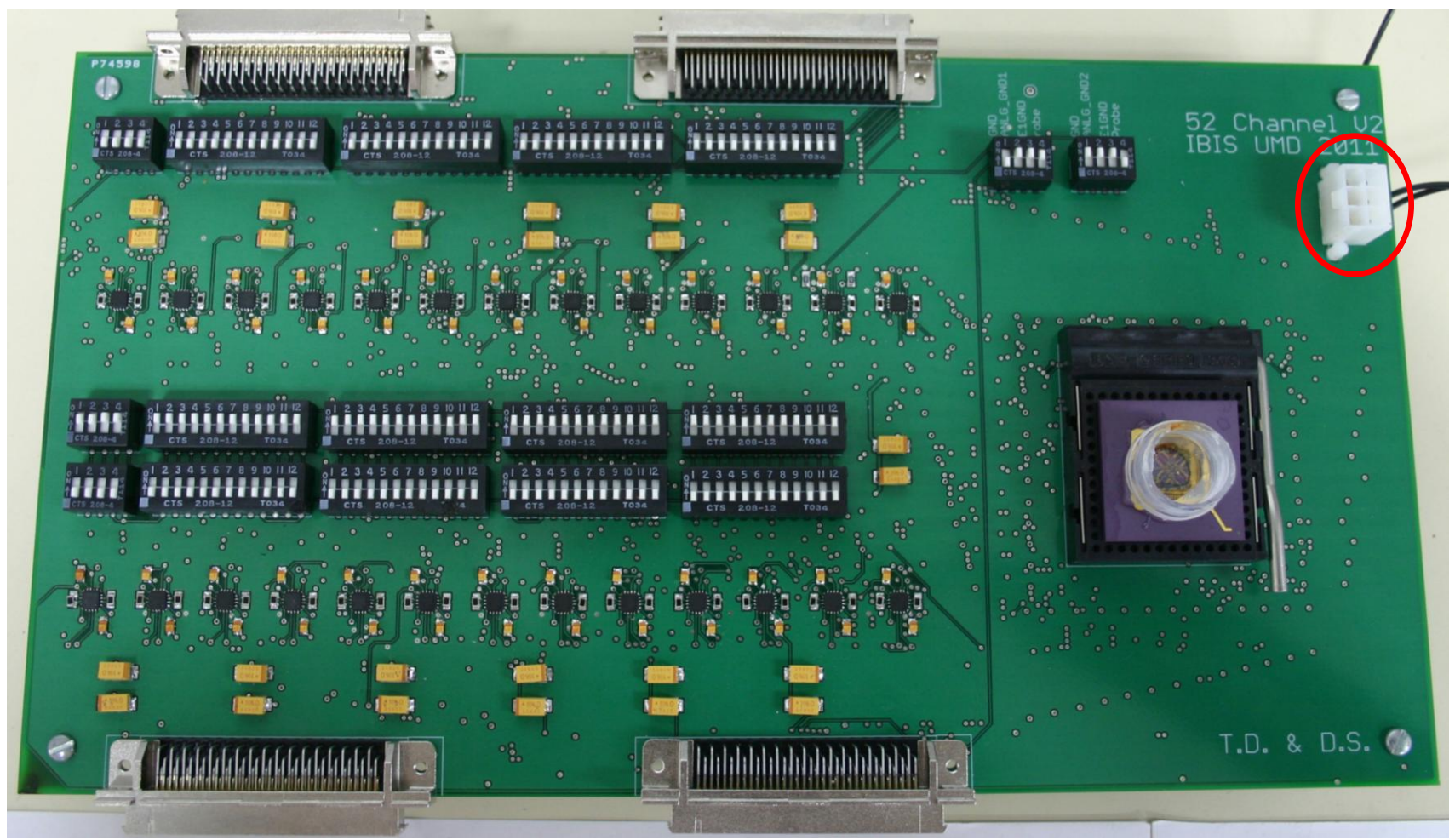
Current Progress: PCB

- Data Acquisition



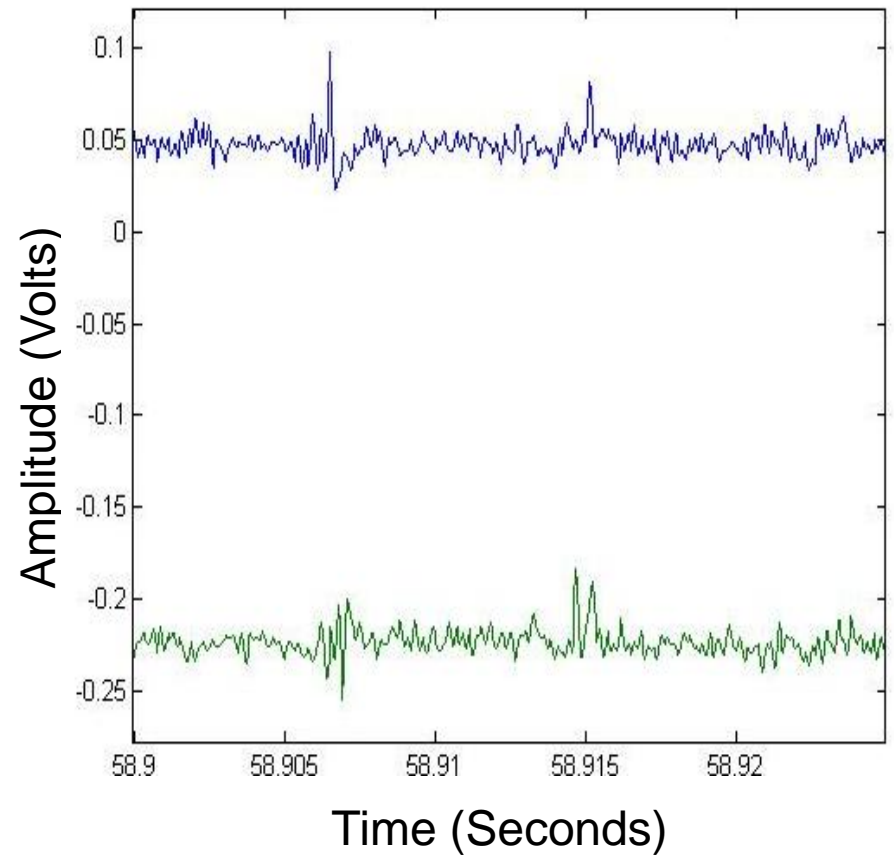
Current Progress: PCB

- Power Planes

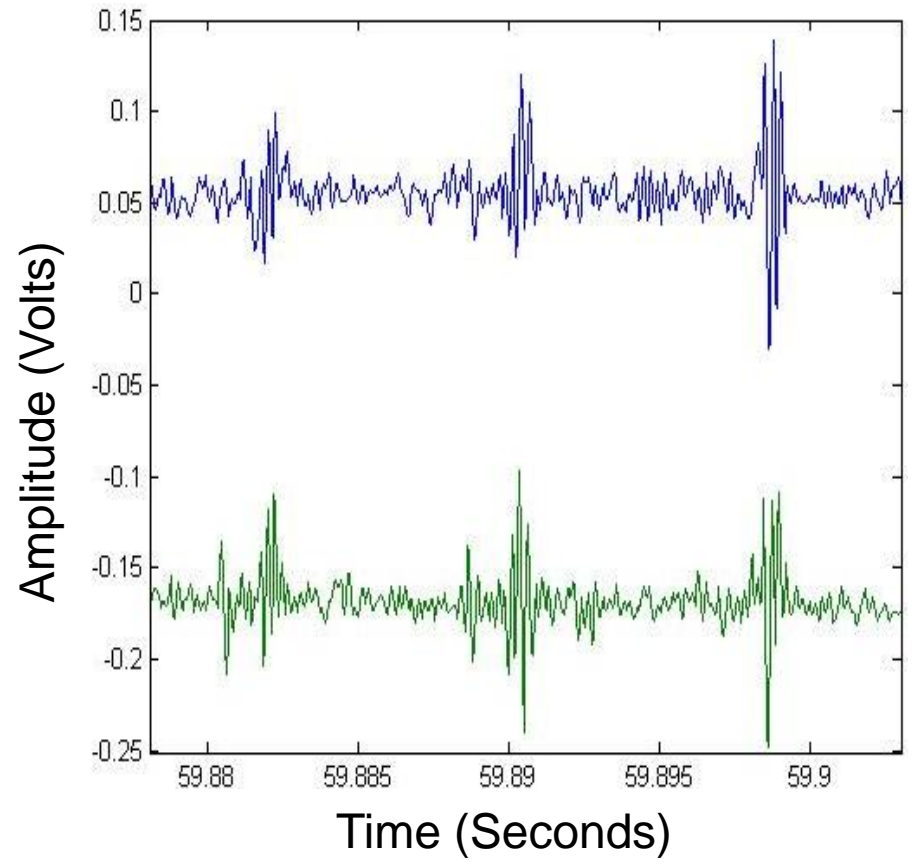


Testing & Results

Before Chemical Stimuli



After Chemical Stimuli

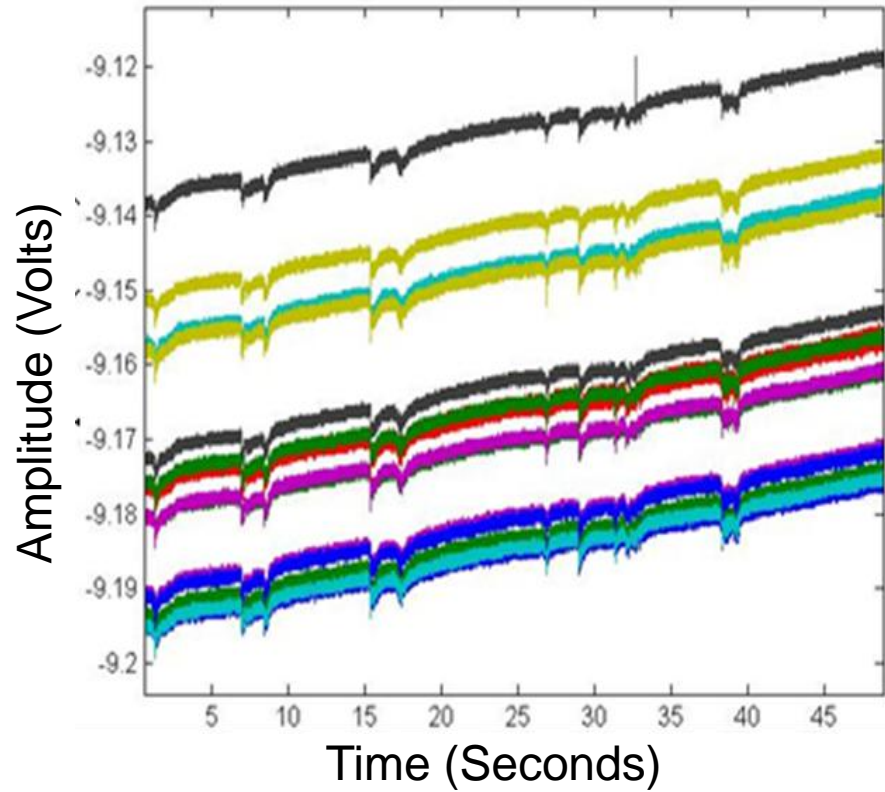


- Bovine Aortic Smooth Muscle Cells (BAOSMCs)
- KCl Chemical Stimulation

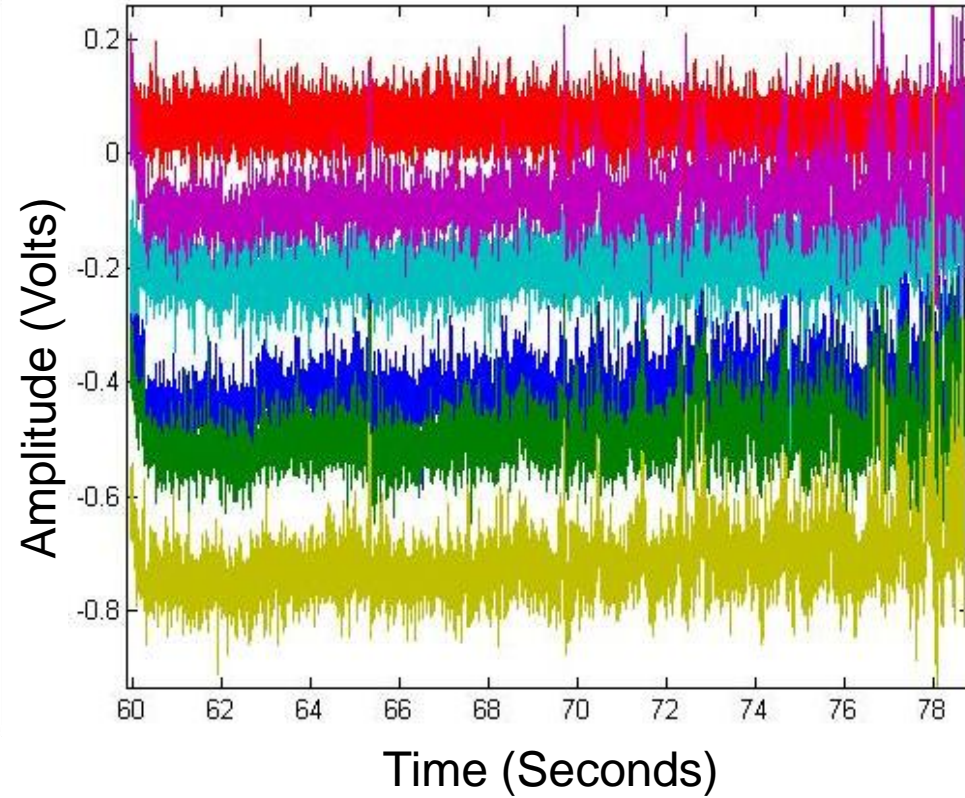


Comparison of PCBs

Previous PCB Output



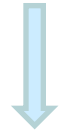
Improved PCB Output



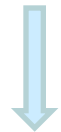
Current Progress: Living Cells

- Addressing ways to prolong cell life
 - Prevent evaporation of cell culture
 - Paraffin Oil
 - Polydimethylsiloxane (PDMS)
 - Sterile Water

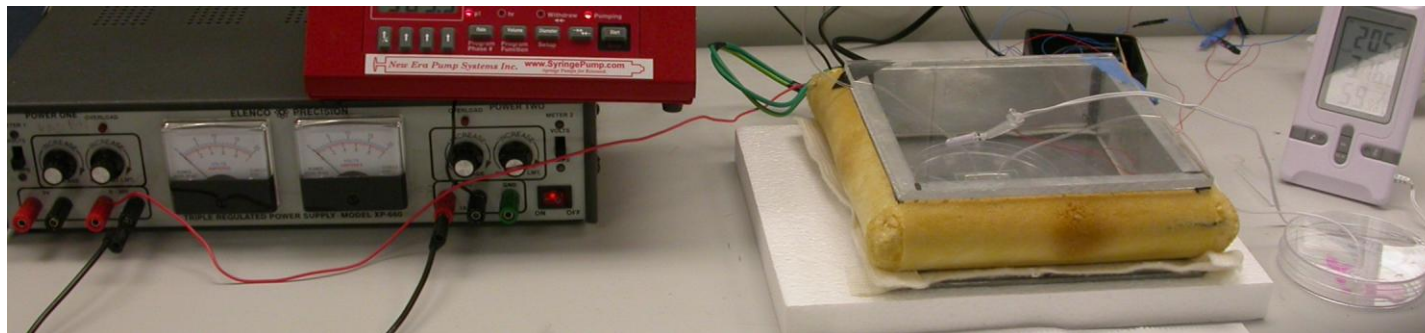
Test
evaporation of
growth medium



Test viability of
cells

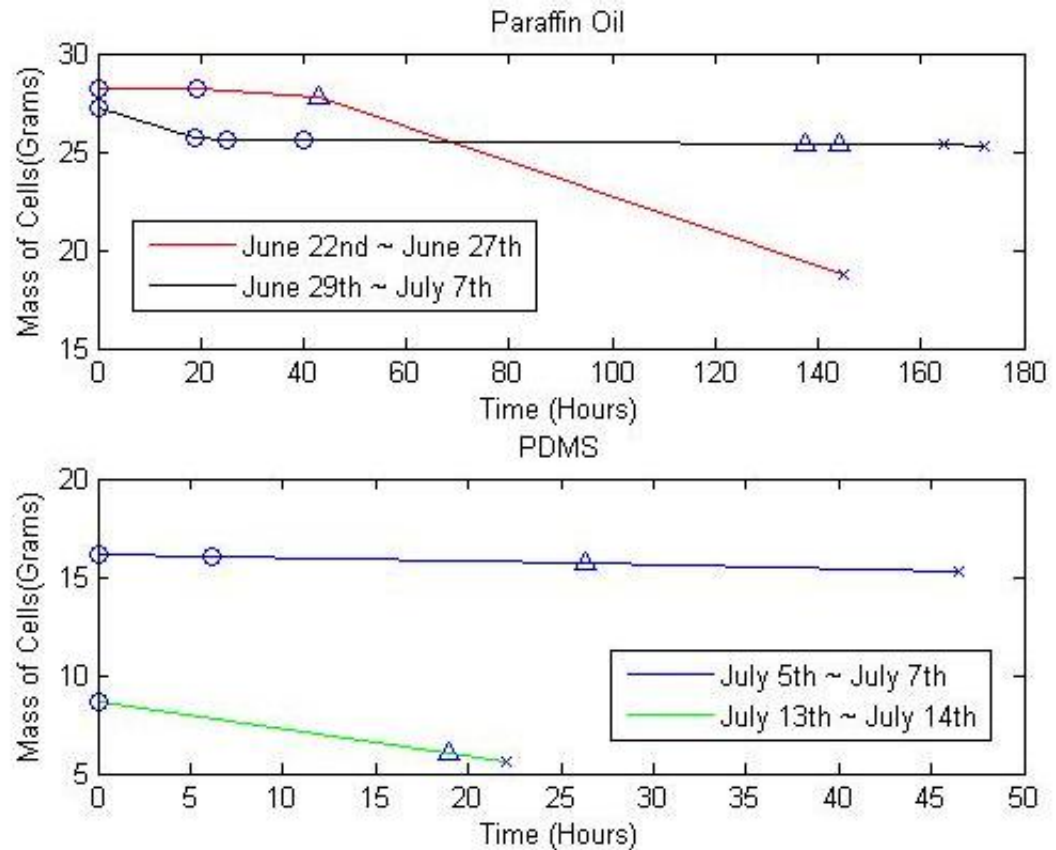


Test
permeability of
membrane





Cell Culture Evaporation



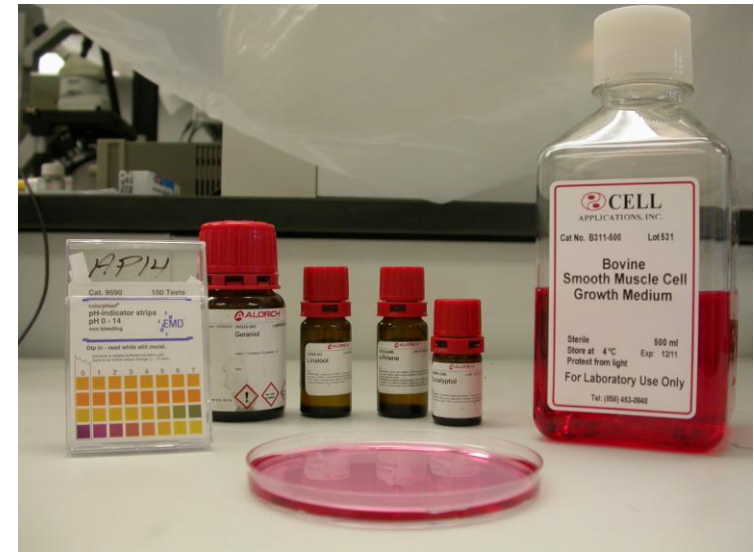
Markers indicate cell health

○ Healthy △ Moderate ✕ Dead

- Paraffin oil and PDMS kept cells viable while preventing evaporation
- Sterile water failed to keep cells alive

Membrane Permeability

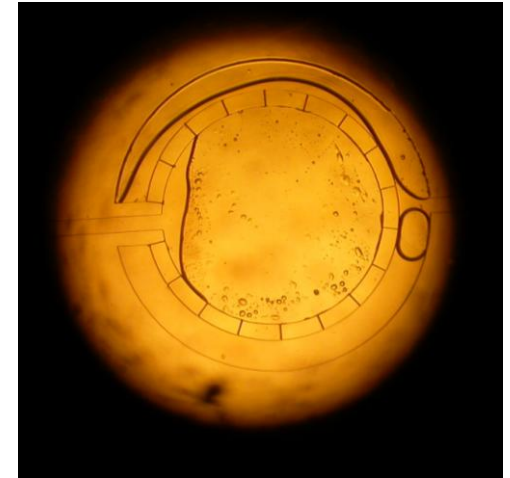
Substance	Visible Penetration	
	Paraffin Oil	PDMS
0.2 M HCl	YES	NO
Geraniol	YES	NO
Eucalyptol	YES	NO
Pinene	YES	NO
Linalool	YES	NO



- Checked for visible penetration across membrane
- Tested CO₂ permeability

Additional Research

- Creating an artificial mucus membrane
- Developing a microfluidics chamber
- Selecting methods for cellular imaging
- Measuring responses of Olfactory Sensory Neurons (OSNs)
- Establishing methods to interpret and analyze the electrical responses in order to classify odors





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Acknowledgments



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