Fabricating Nanotechnology with Graphene
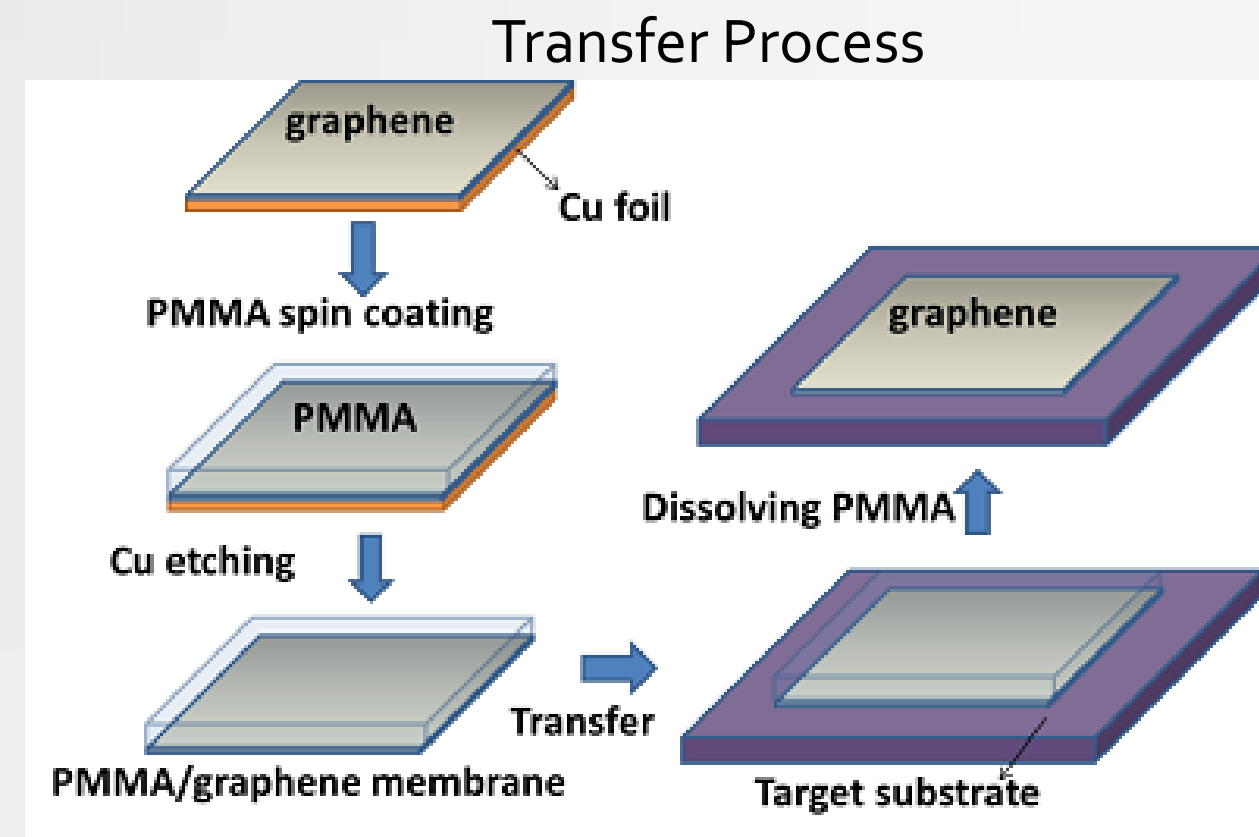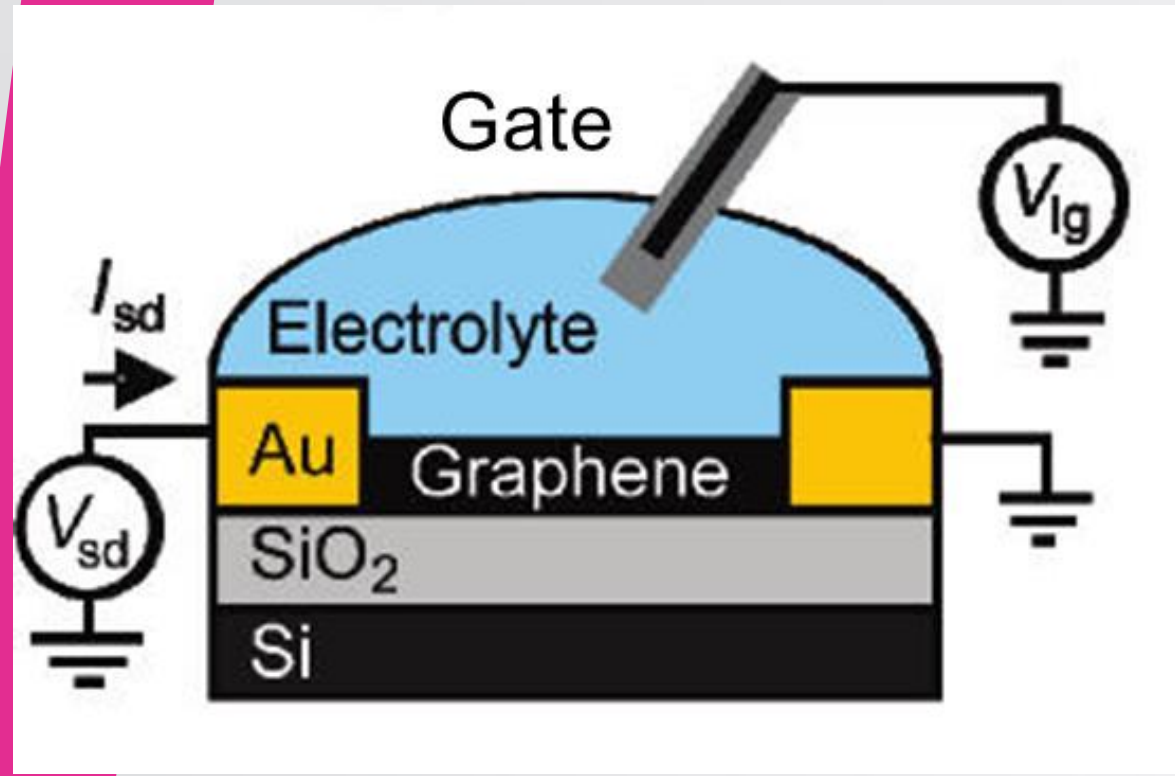
SESEY
Summer Experience in
Science and Engineering for Youth

By: **Christopher Diaz and Ian Diaz** ⬅ (We are not related)
Mentors: **Mitch Senger, Carly Fengel, Daniel Mclulley, Morgan Brown**
Project Sponsor: **Dr. Ethan Minot**
Department of Physics and Nanotechnology lab

Transfer Process

Fabrication

➤ Transferred graphene from copper to chip
➤ Mask placed into multiple developers. The mask was a positive photo developer.
➤ Mask washed with distilled water between developers.
➤ Design slowly appeared as mask developed further.
➤ Mask placed onto microscope, wafer placed under mask, and microscope exposed mask and wafer to high dosage of UV mercury lamp.
➤ UV Mercury lamp imprinted design from mask onto wafer.
➤ Wafer and mask checked for quality under microscope.

Completed Device (Electrolytes are for testing on probe station)

Mask Design
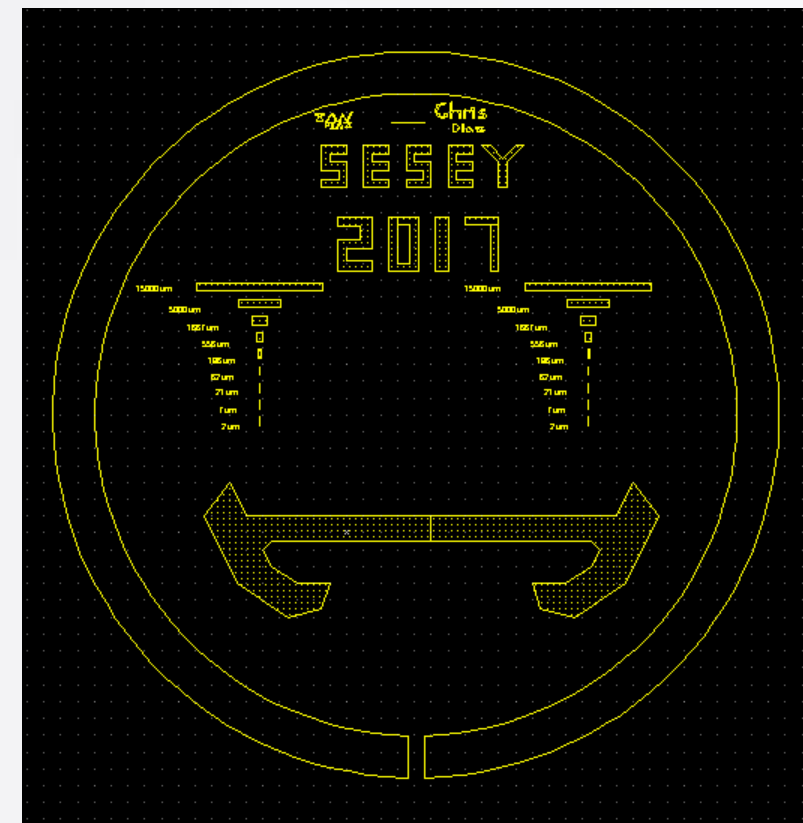
AFM Schematic
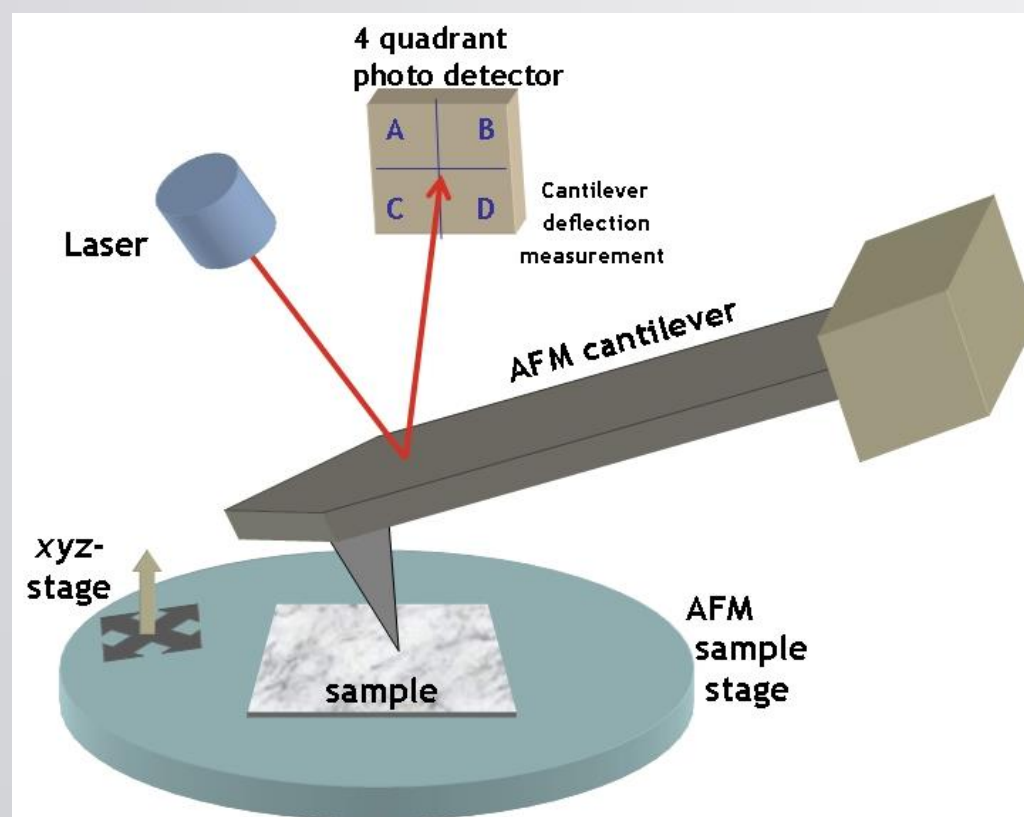
## Atomic Force Microscope (AFM)

Sharp tip on cantilever osculates up and down on the substance's surface adjusting as the surface changes. This creates a topographic map of the substance's surface. A laser reflects off of the top of the cantilever and into a photo detector, which is used to monitor the position of the tip.
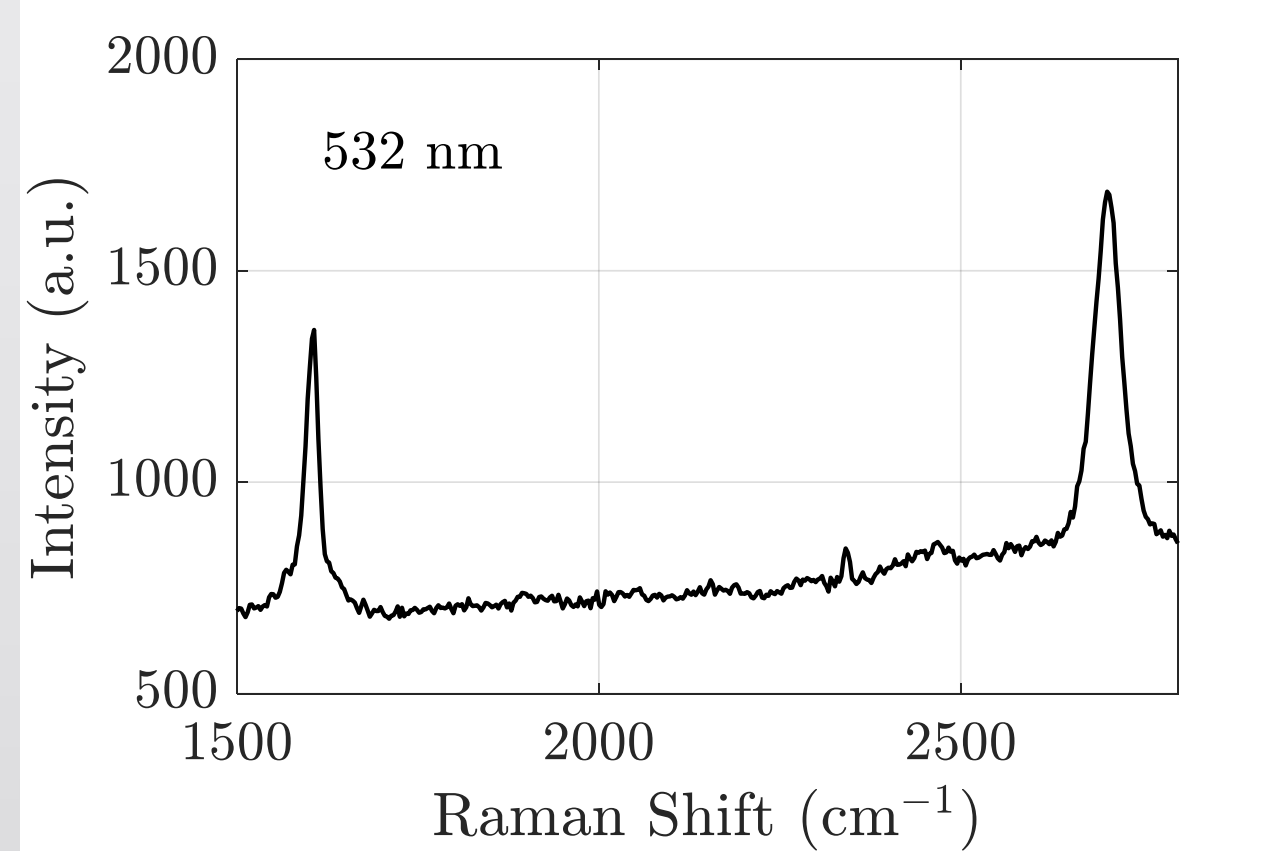➤ Image on far right graphs where the graphene (Gold color) is on a chip

AFM Image
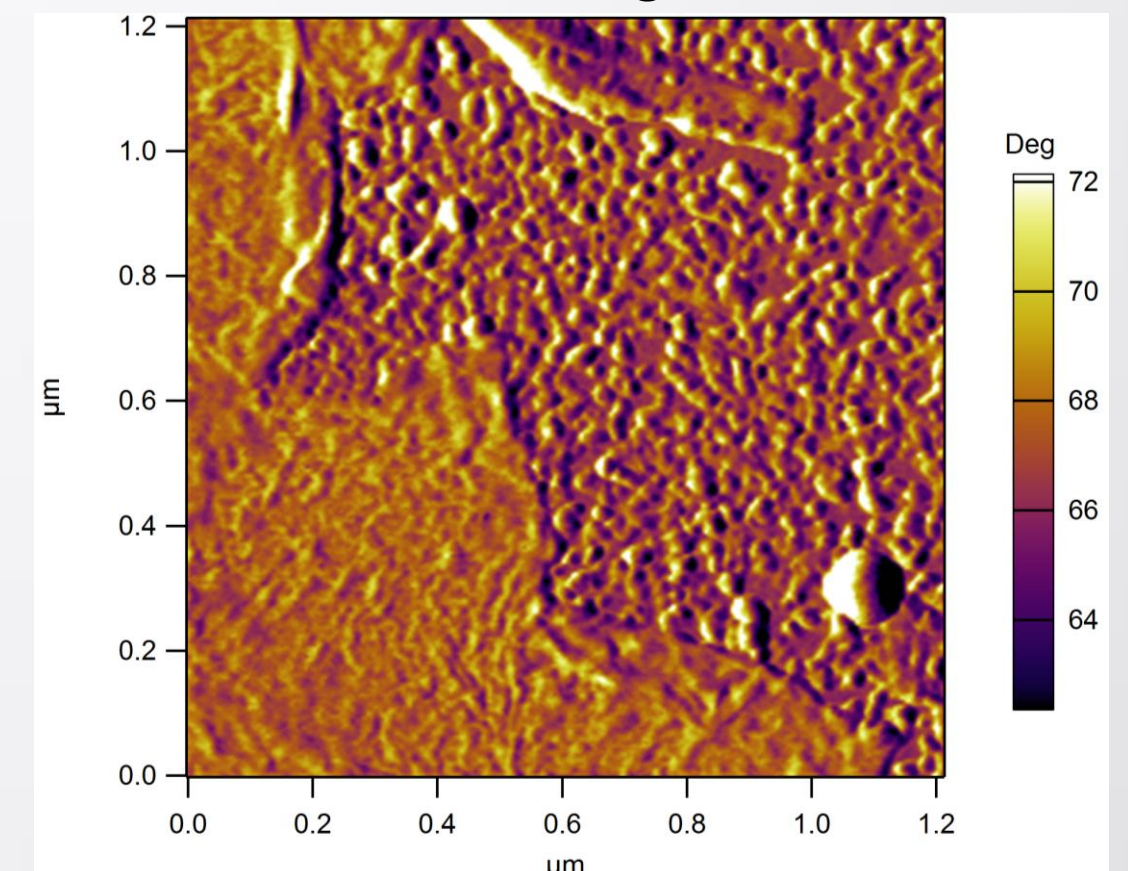
Known Raman Spectra
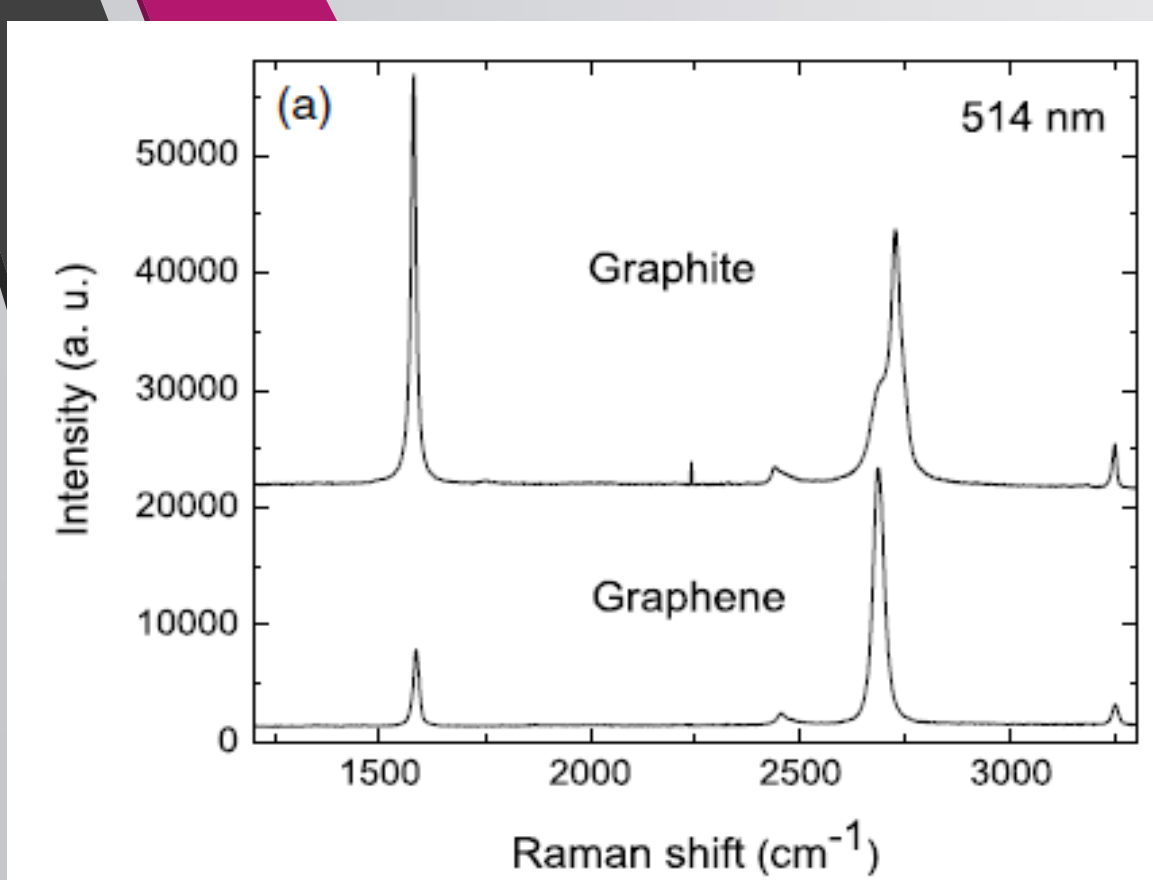
Our Raman Spectra of Graphene

Raman Spectroscopy

Measured light returned from substance in order to determine how many layers and what substance was being tested.
➤ Measures shift in wavelength of returning light
➤ Graphed intensity of returning light
➤ Shift of light intensity is unique to each material
➤ Compared our data to known data in order to confirm that our material was somewhat graphene, and with around 4-5 layers.

Ion Concentration Sensing Results


Semiconductor Probe

Probed gold electrodes to measure electric current flowing through a chip. The measurement is a measure of how well electricity is transmitted by the chip.
➤ By changing the properties of the liquid used in the lab we were able to change to the behavior of the device
➤ The current would flow though the source though the graphene into the drain
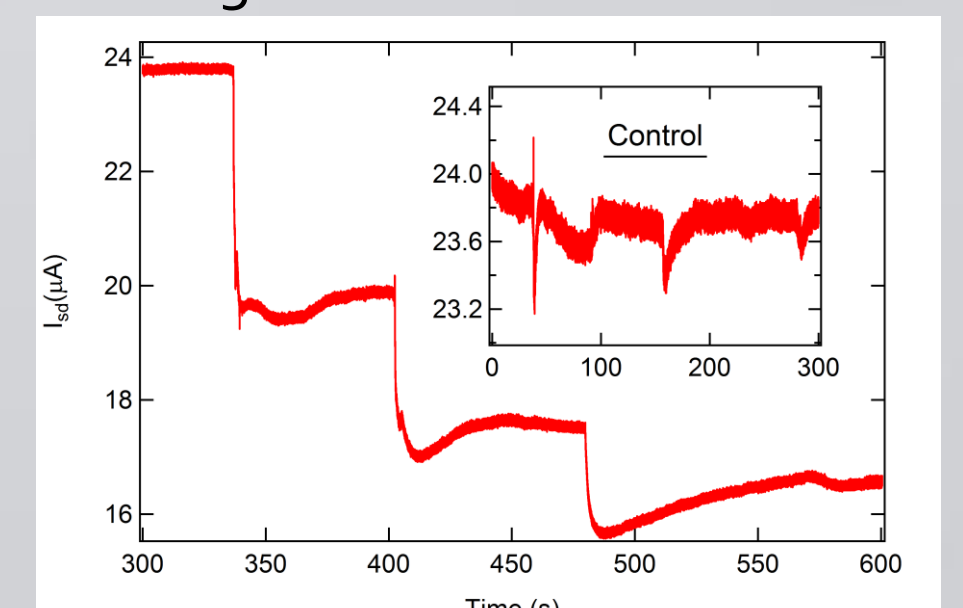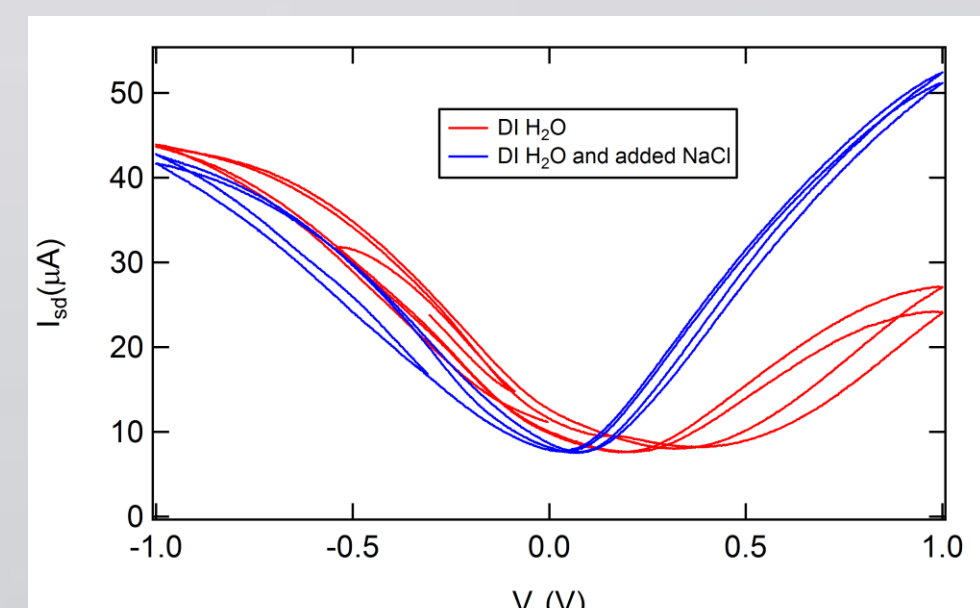
pH Sensing Results
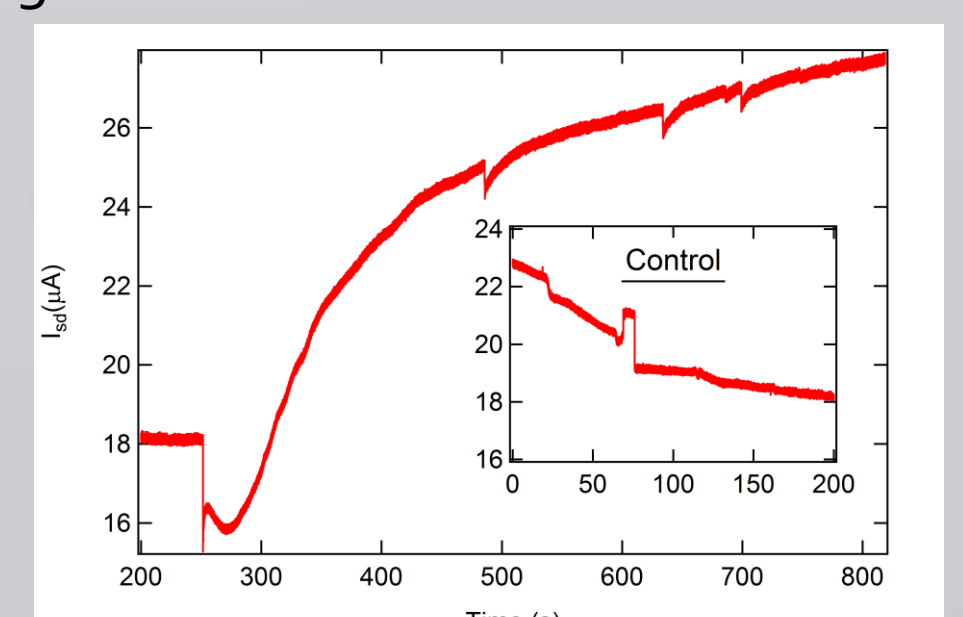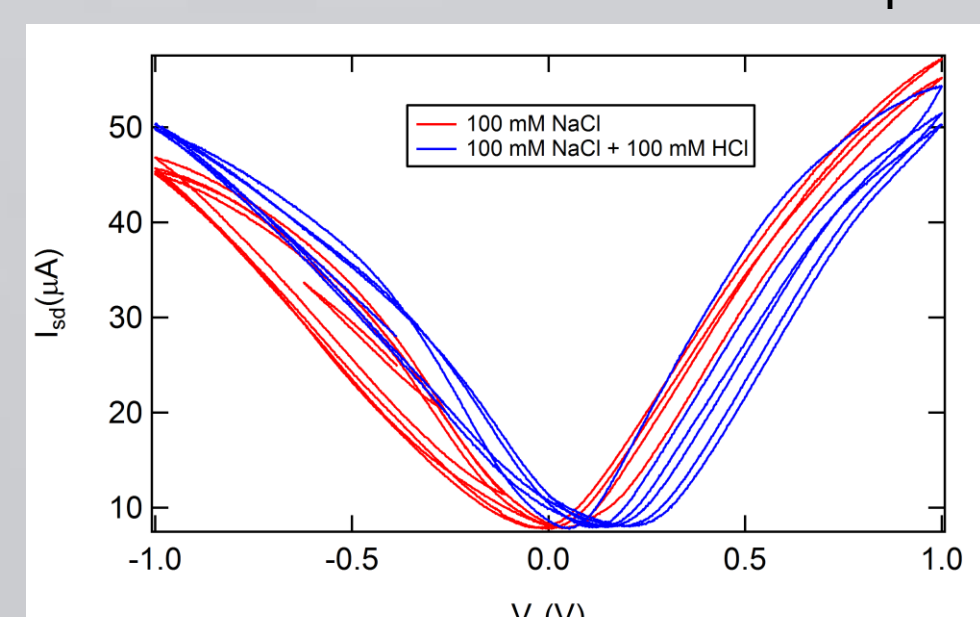
Acknowledgements

➤ We are very appreciative that Dr. Ethan Minot sponsored our project as well as assisted us in the lab.
➤ We also appreciate the work our many mentors did with us throughout the project. Their names are Mitch, Carly, Daniel, and Morgan.
➤ Lastly, we would like to thank Dr. Skip Rochefort for giving us the opportunity to conduct this insightful project.