

# Analysis of Fused Thiophene Polymer Field Effect Transistors (FET)

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CORNING

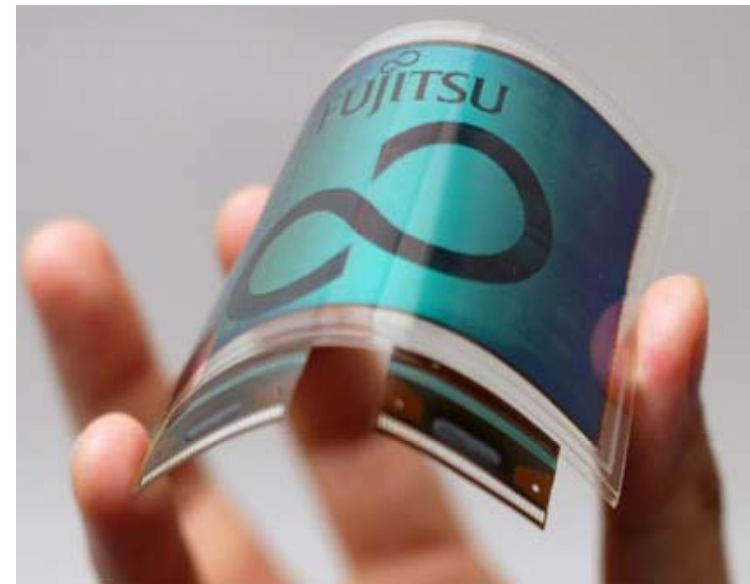


# Polymer FET Importance

Low cost manufacturing  
Low energy fabrication  
Low environmental impact



Versatile processing

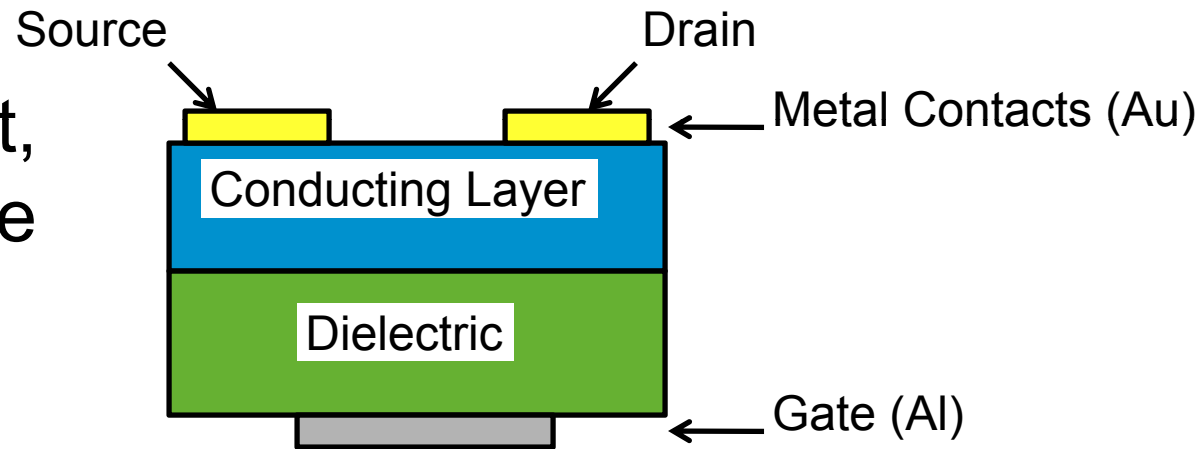


Flexible substrates

# Field Effect Transistor (FET)

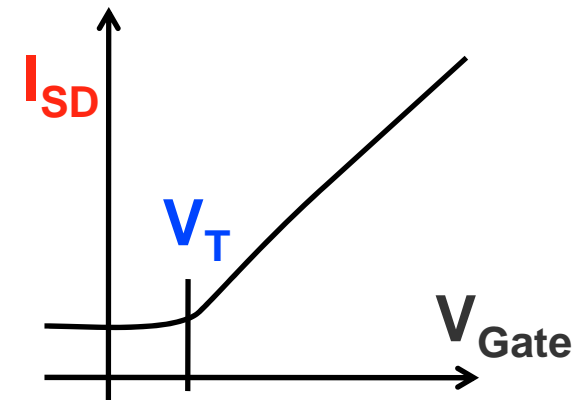
1. Transistors are logic switches
2. Controlled by a gate voltage

Top Contact,  
Bottom Gate  
Structure

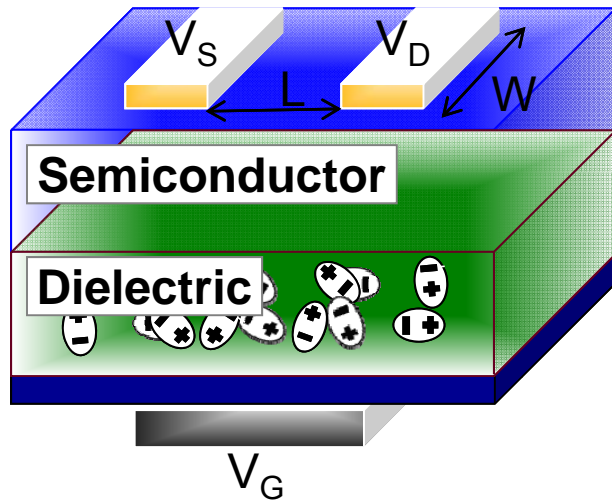


3.  $I_{SD} = \frac{W}{L} \cdot \mu \cdot C_i \cdot f(V_{G,S,D,T})$

4.  $\Delta V_T \cong \frac{I_{SD}}{f(geometry)}$

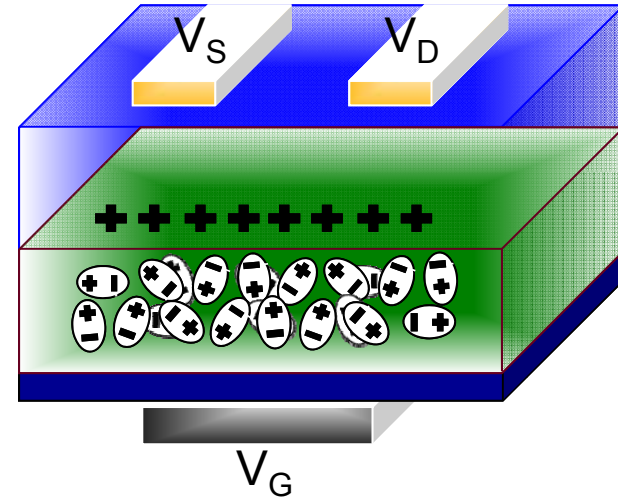


# PolyFETs and Doping

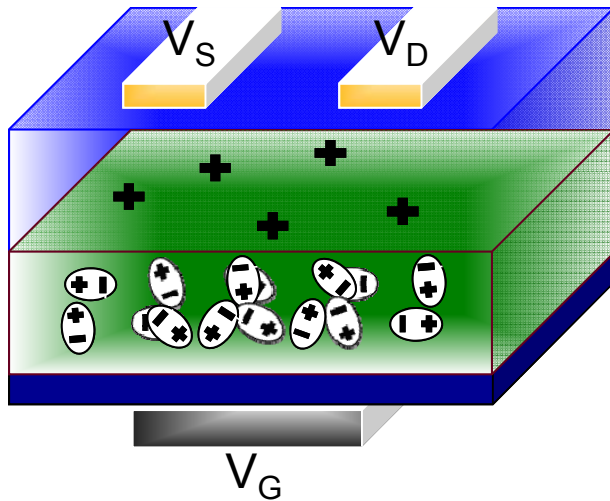


Off:  $V_G = 0$  V,  $I_{SD} = 0$  A

Normal  
Operation



On:  $V_G < 0$  V,  $I_{SD} < 0$  A



Off:  $V_G = 0$  V,  $I_{SD} \neq 0$  A

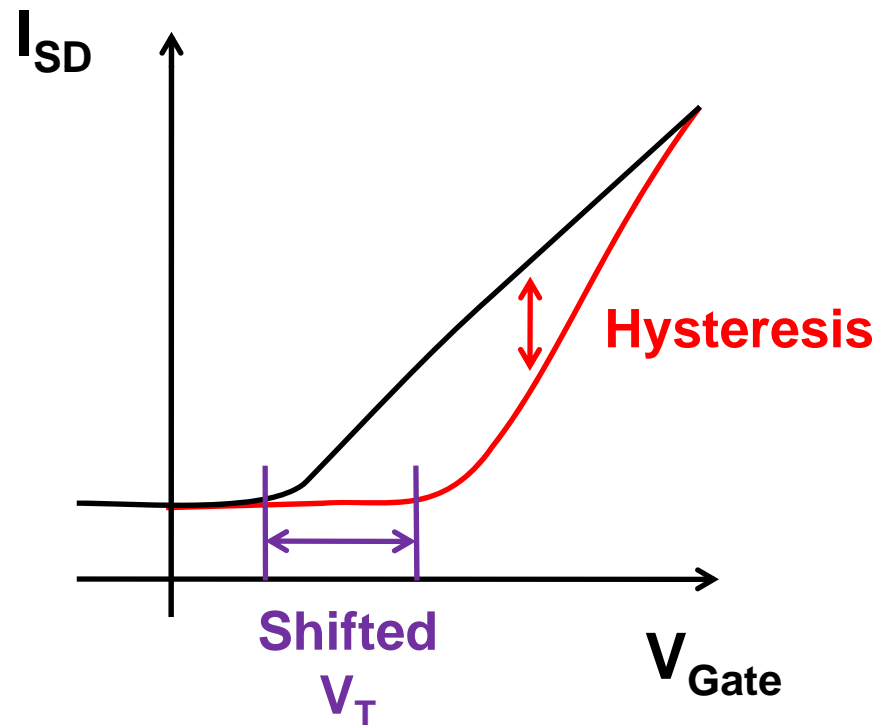
←..... **Doped PolyFET:**  
In off state  
current still flows  
(always On!)

# Goals

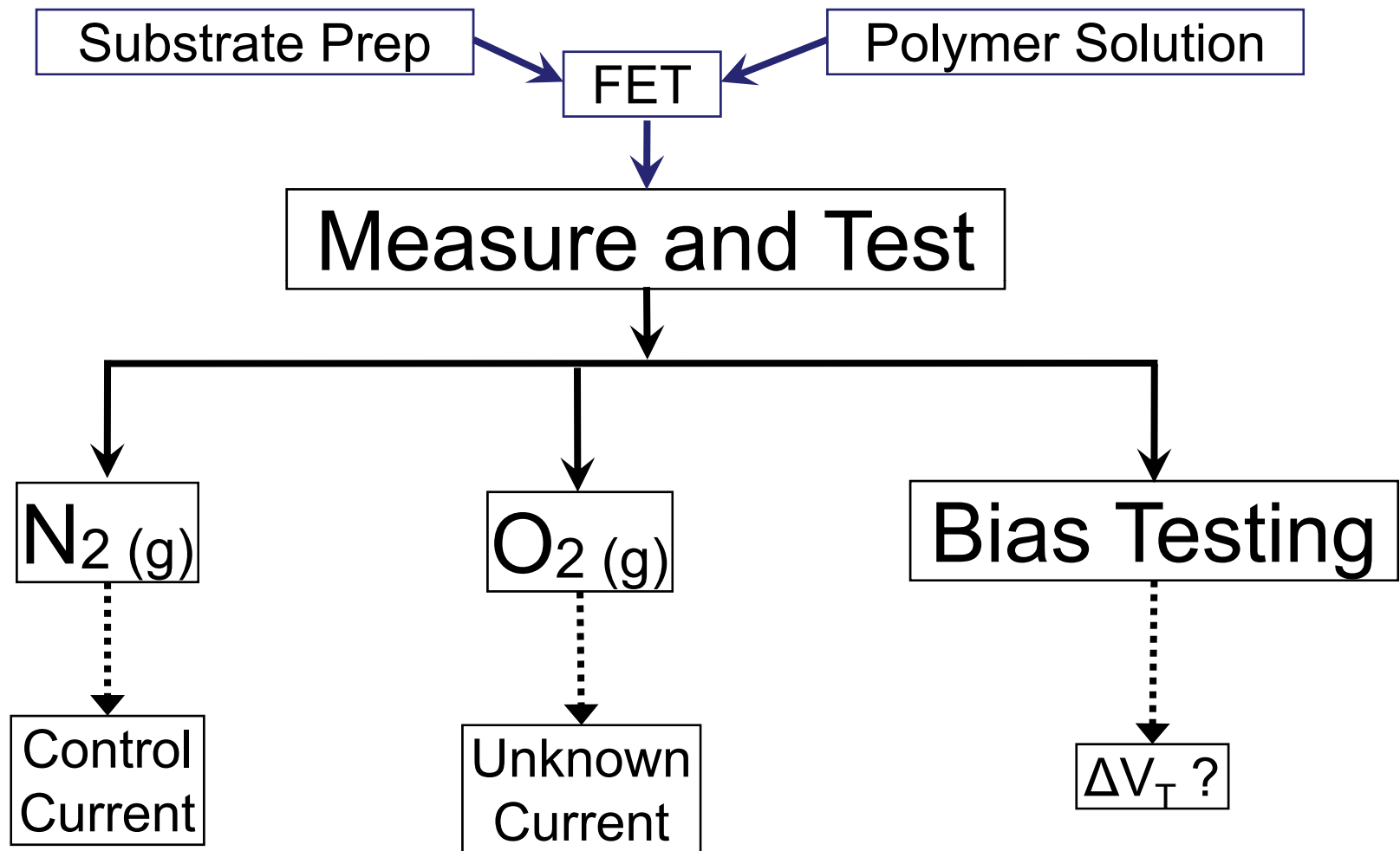
Define ideal operating parameters for viable commercial devices.

## How?

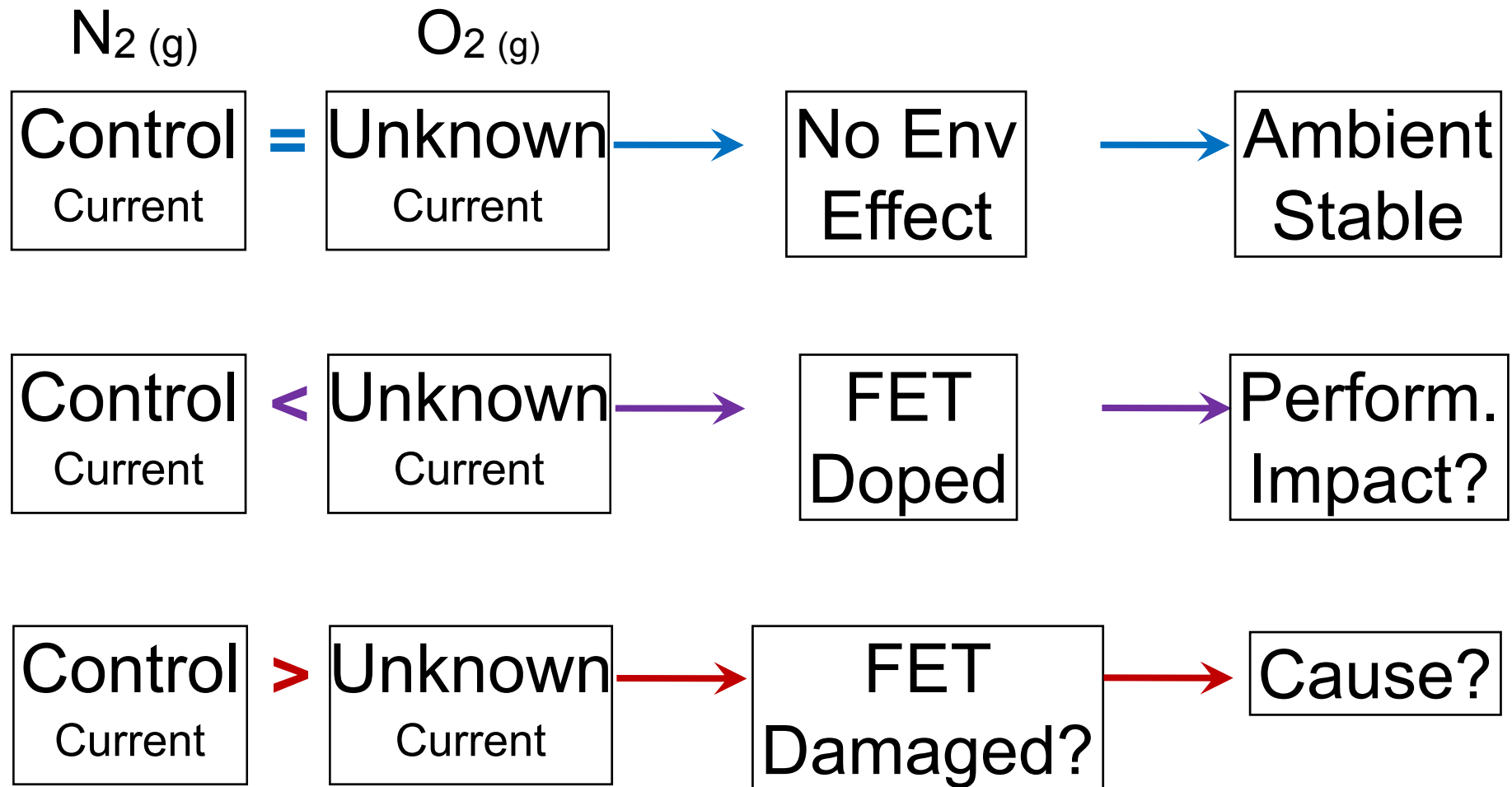
- Ambient Impact
  - $N_2$
  - $O_2$
- Bias Stress



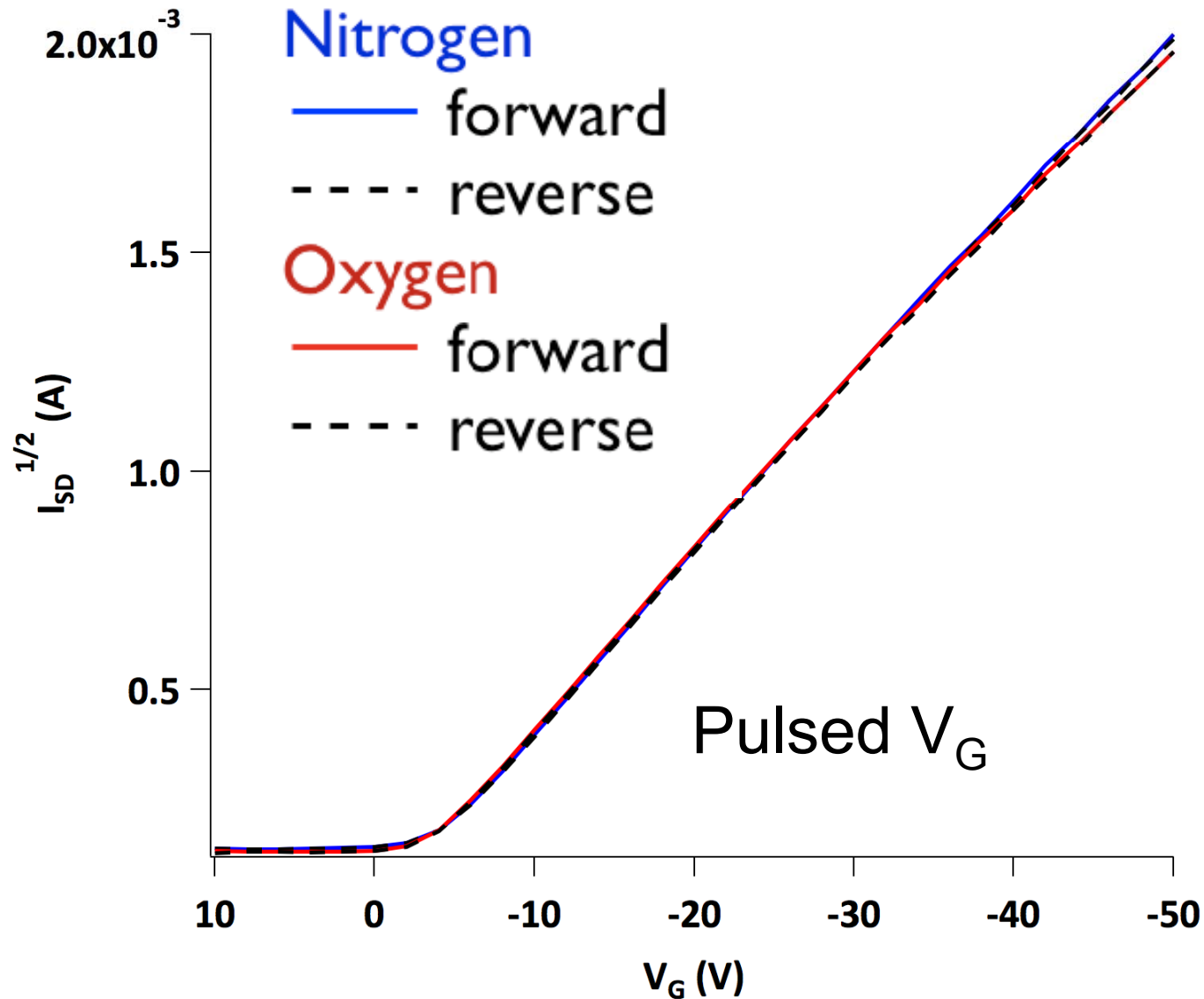
# Experimental Methods



# Experimental Methods

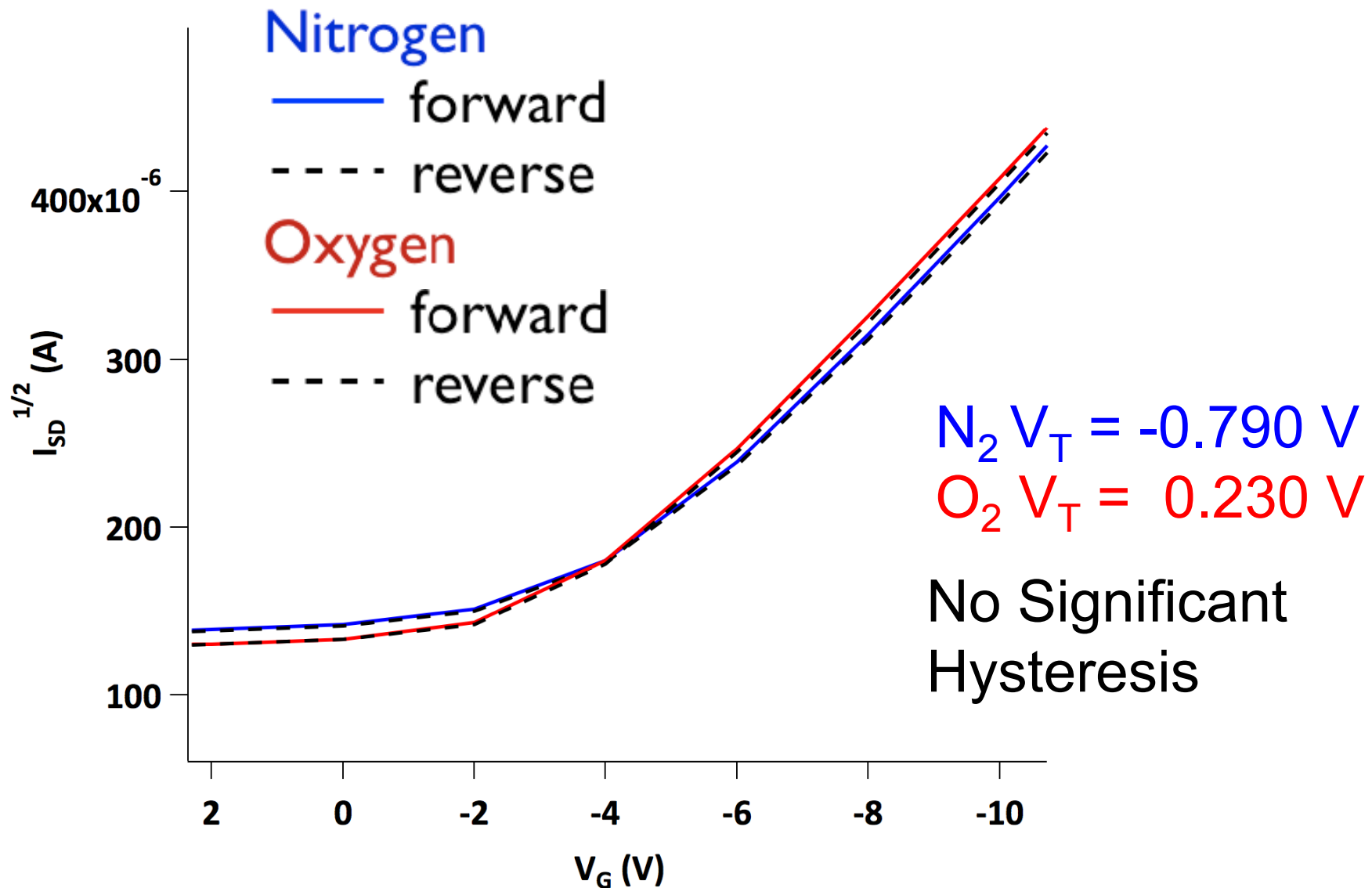


# Research Data – Dopant Effects

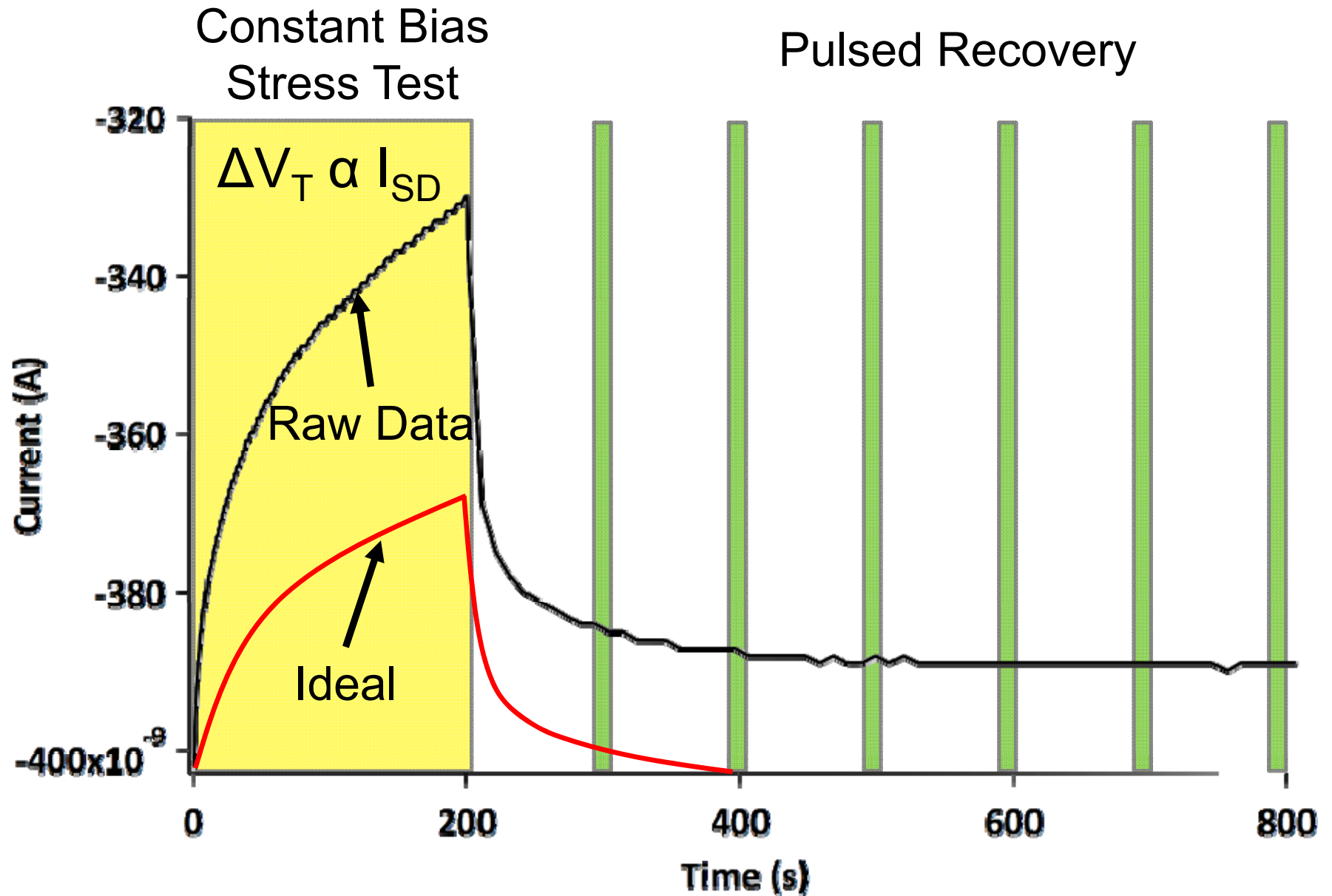




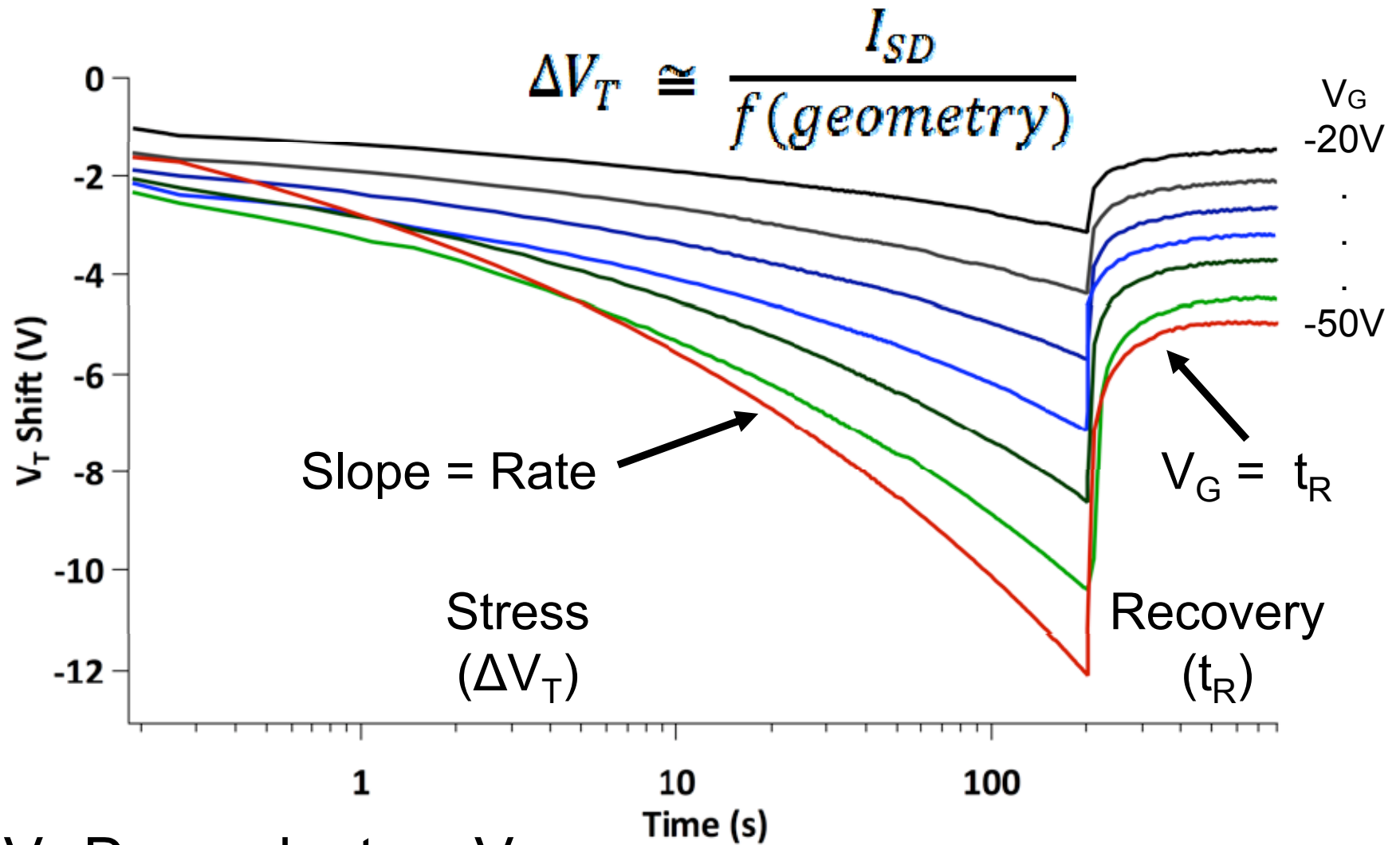
# Research Data – Dopant Effects



# Research Data – Bias Meas.



# Research Data – $V_T$ Results



$\Delta V_T$  Dependent on  $V_G$

# Conclusions

- O<sub>2</sub> and N<sub>2</sub> device results - comparable
- Minimal hysteresis for pulsed operation
- V<sub>T</sub> shift is V<sub>G</sub> dependent - normal
- Quick recovery under bias testing
- No permanent damage under bias testing

## On-going research:

- Finish bias testing conditions
  - O<sub>2</sub> and H<sub>2</sub>O
- Look at different dielectrics
  - polystyrene, poly(methyl methacrylate)

# Acknowledgments

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- Corning for the funding and material
- SBCC and UCSB without whom this would not be possible
- My mentor Justin Cochran for answering too many questions
- Professor Michael Chabynec for the lab
- Maw and Paw for making all this possible



# Experimental Methods

