

NIST

National Institute of
Standards and Technology

Hydrogenating the Surface of Diamond

Colin Myers



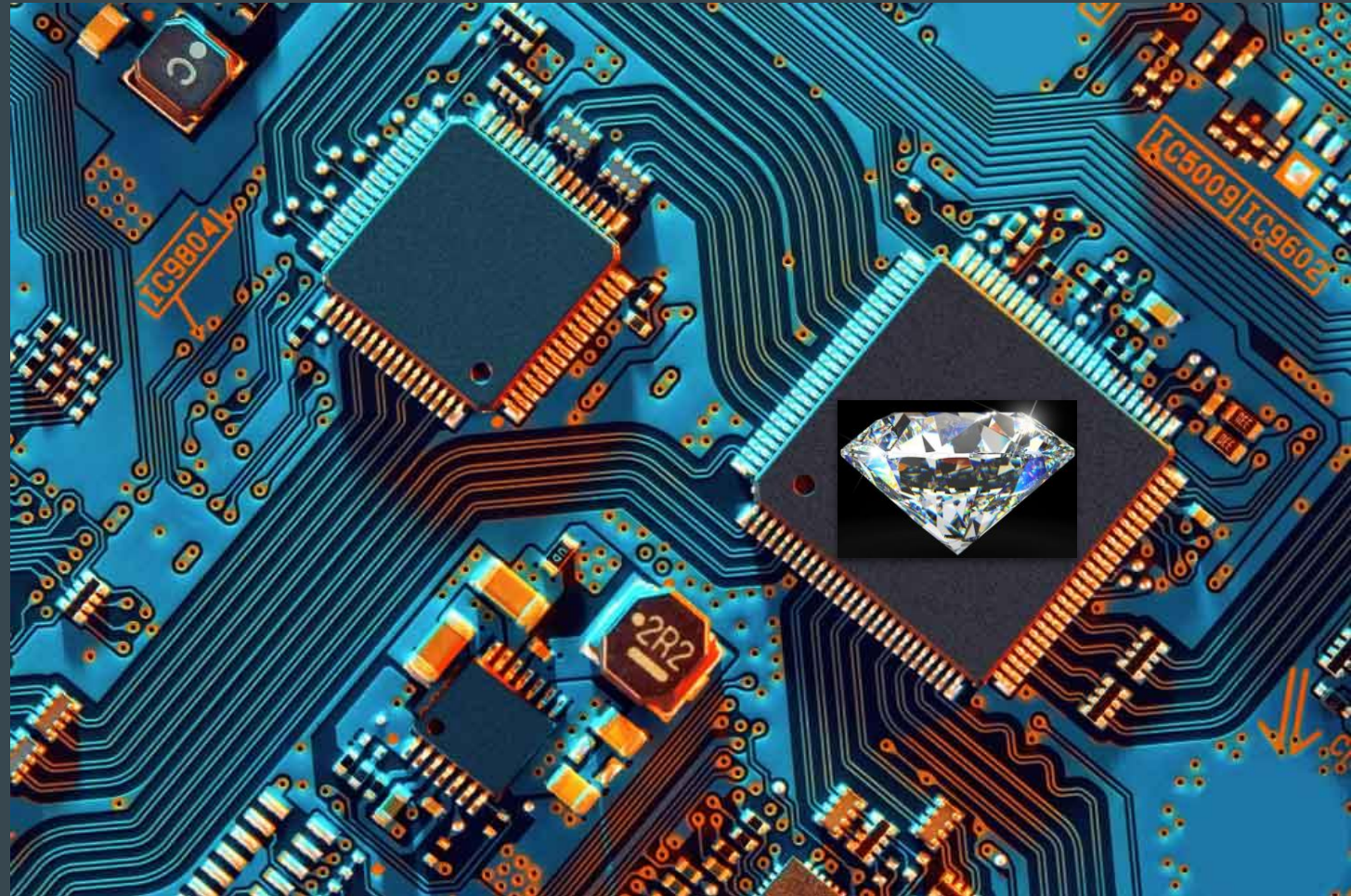
Millersville University

Introductions

- Millersville Senior
- Physics & Math
- Mentor - Dr. Andrei Kolmakov
- NIST - Physical Measurement Laboratory - Advanced Electronics

Why Diamond?

- Thermal Conductivity
- Radiation Damage Resistance
- High Power Inputs
- High Carrier Mobility
- High Breakdown Voltage
- Robust Material



(Casa D'Oro, 2022)

(electronic circuitry, 2023)

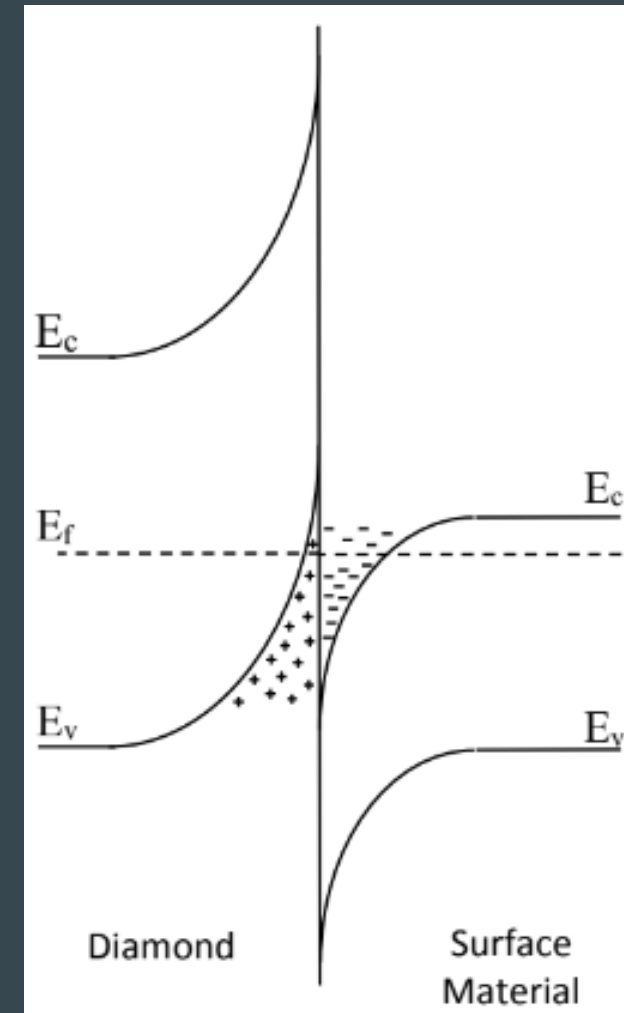
Doping Diamond

- Increasing Electrical Conductance
- Impurity Doping challenging
- Transfer Doping
- Band Bending

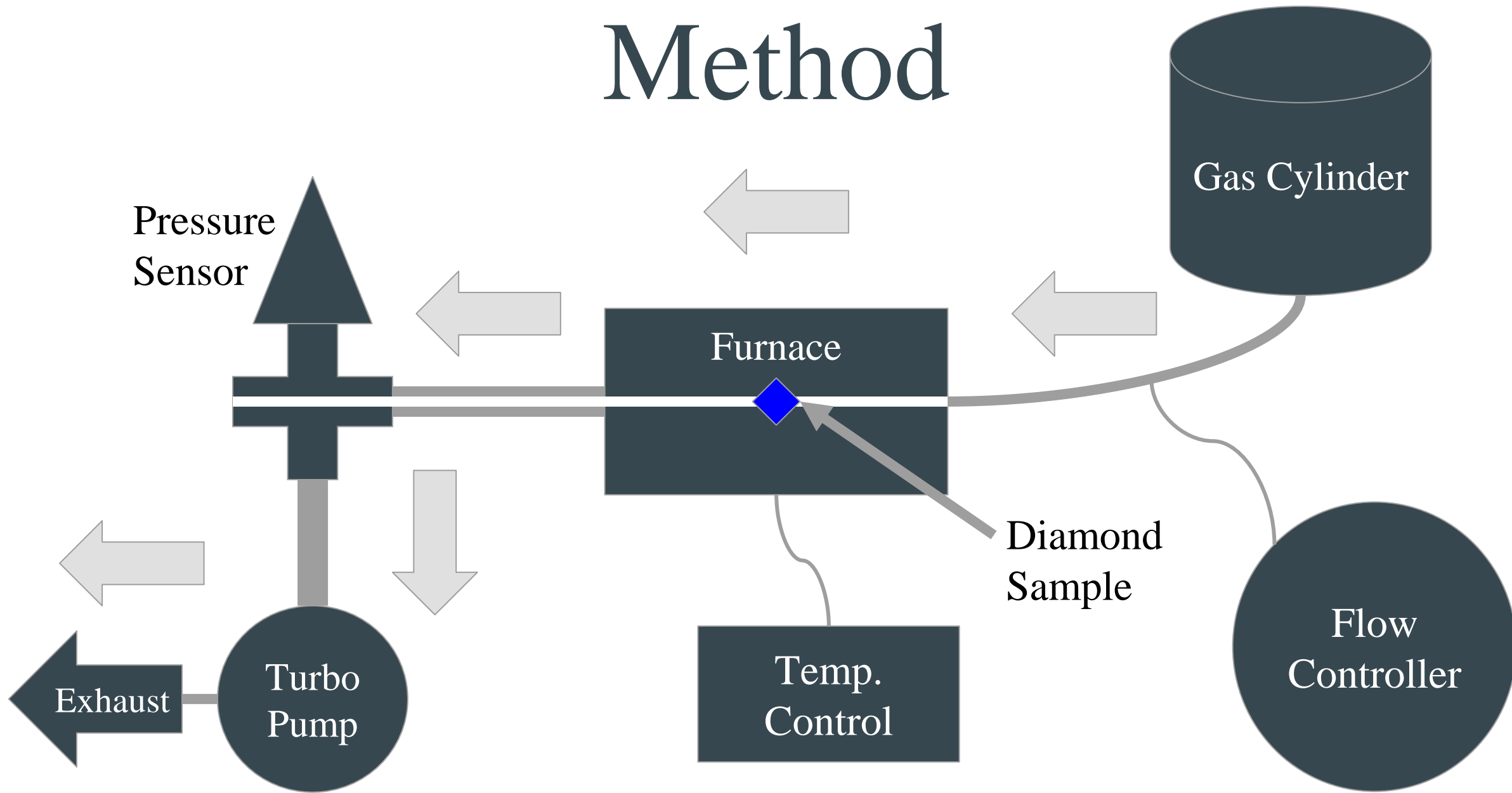


(PCD during growth, 2018)

(Crawford, 2017)

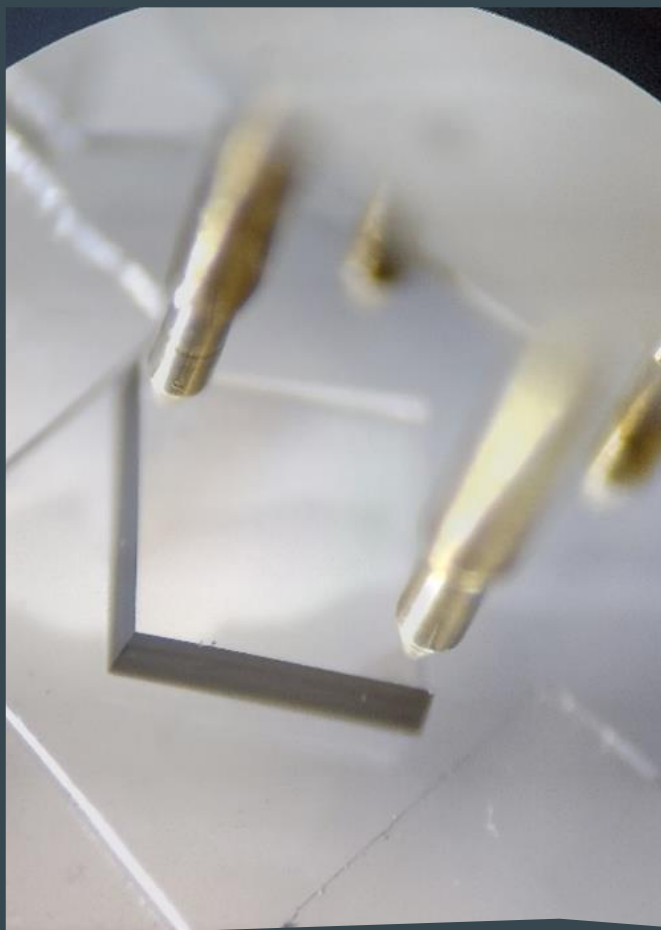


Method

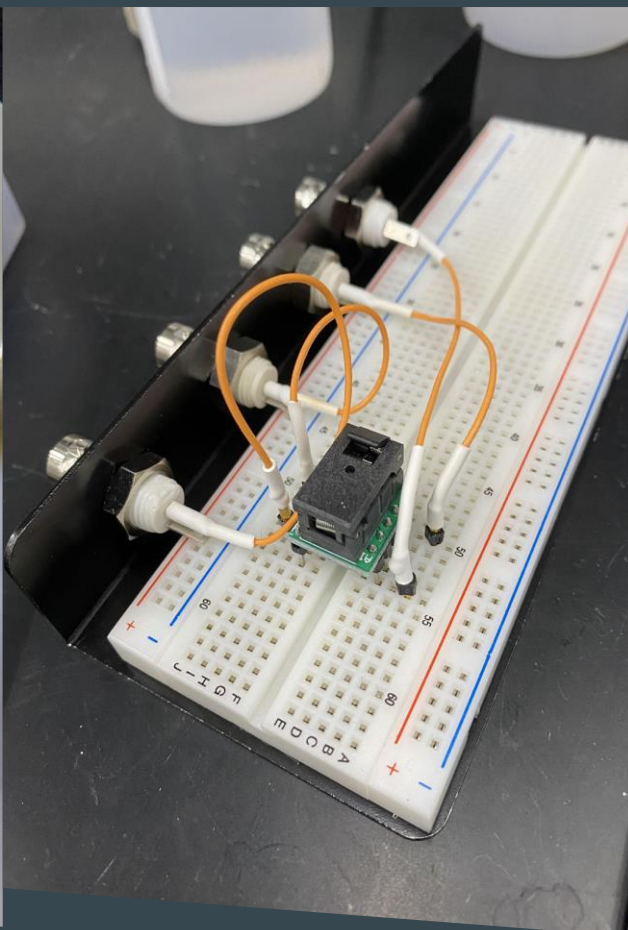


In The Lab

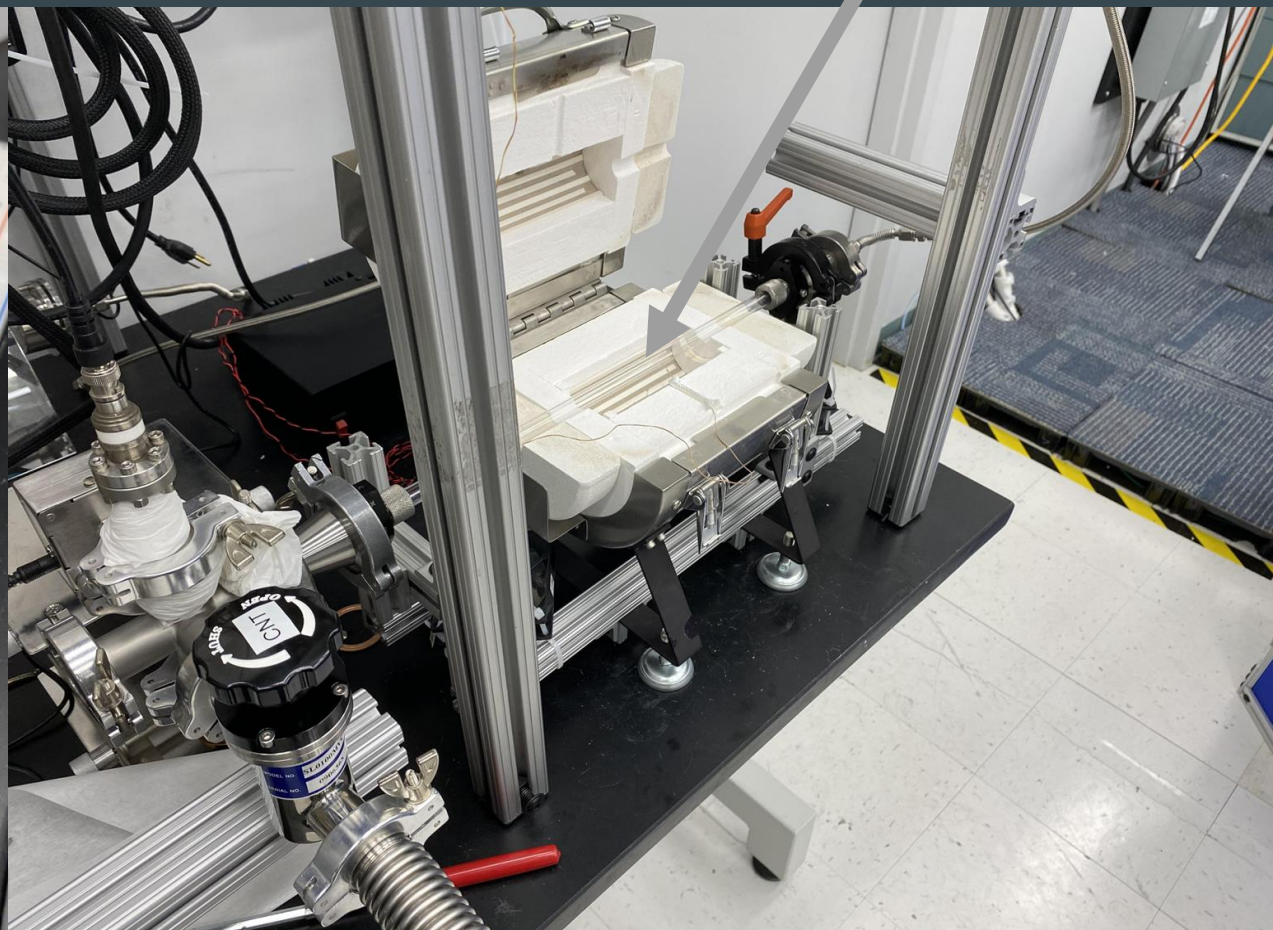
Sample Placement



Two Probe Setup



Four Probe Setup



Hydrogenation Setup

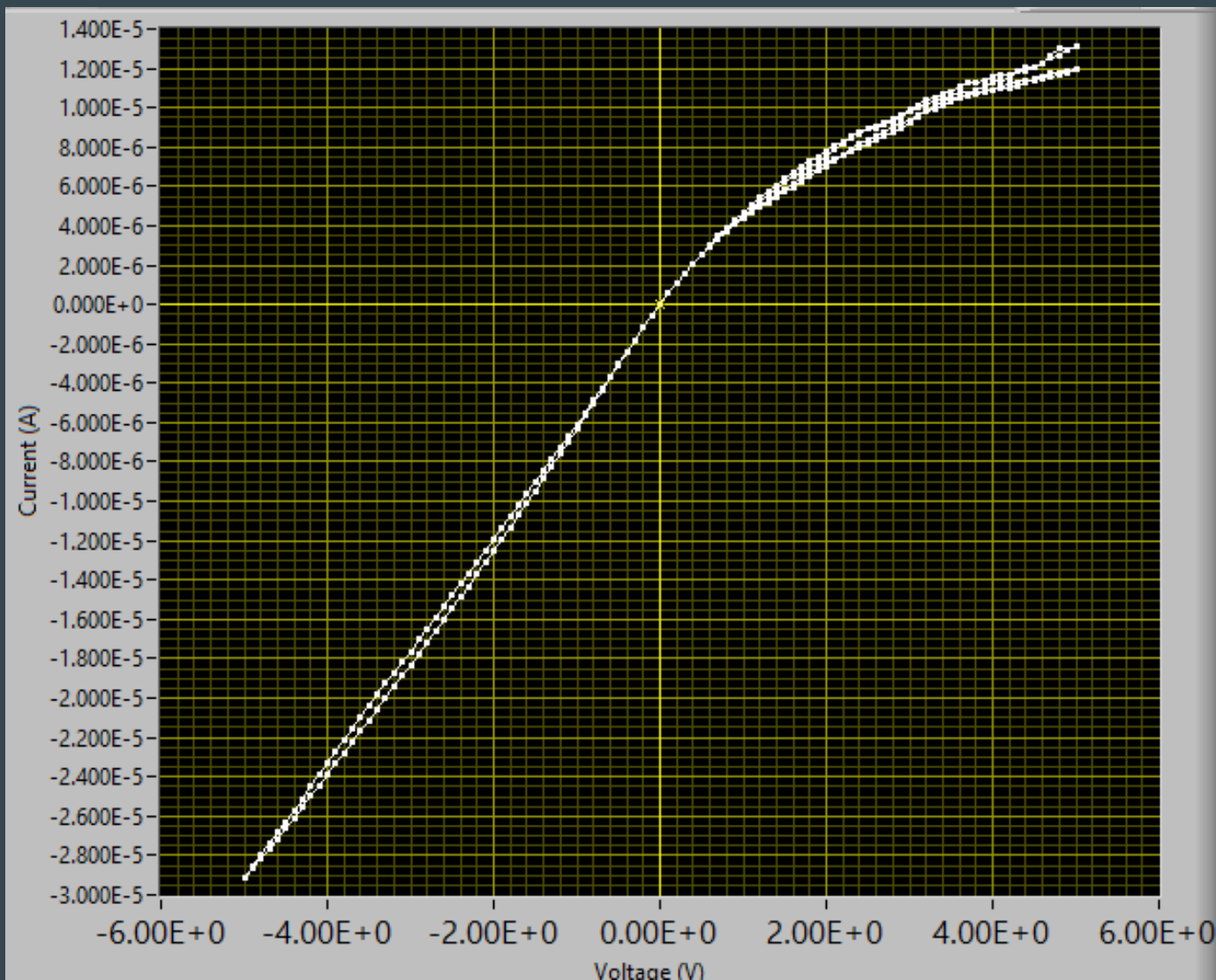
Discussion

- Ohmic vs Non-Ohmic (right)
- Four Probe Formula (above)
- 700-1000 k Ω
- Ideally 10x improvement
- Progress!

Challenges

- Polishing (roughness)
- Gas (Oxidative) Impurities
- Time allotment

$$\rho_{sheet} = \frac{\pi}{2 \times \ln(2)} \left[\frac{V_{43}}{I_{12}} + \frac{V_{14}}{I_{23}} \right]$$



Future Plans

- Lithography
- Electrical Devices
- Hall Measurements

Acknowledgements

- Dr. Andrei Kolmakov
- NIST ITAC
- AIP & SPS
- Fellow Interns

Citations

- Casa D'Oro: Diamonds & Fine Jewelry. (2022, March 3). [Image of diamond]. casadoro.com. <https://www.casadoro.com/blog/what-is-diamond-brilliance/>
- Crawford, K. G. (2017). [Diagram of Band Bending]. <http://theses.gla.ac.uk/8561/>
- *electronic circuitry*. (2023). wellpcb.com. <https://www.wellpcb.com/current-limiting-circuit.html>
- *PCD during growth*. (2018). <https://plassys.com/diamond-coating/>