

SAN DIEGO STATE

Project Description

In collaboration with Dr. Meysam Heydari Gharahcheshmeh, Team No Pressure was given two CVD reactors, and were requested to update both systems in order to make their manufacturing process more efficient.

The team was requested to :

- Reduce the volume of the reactor while not interfering with the deposition.
- Adjust the physical and digital means of heating control, in order to give more accurate results, with less overall deviation from the setpoint, along with optimizing the pressure control if time permits.

System Level Diagram

$\left(\right)$	Glass Via
\bigcirc	Ball Valv
\bigotimes	Needle V
	Gas Tank
\square	Trap Filte
\bigcirc	

Glass	Vial	

Vial		



Tank

Filter

[•] Pressure Transducer

Mass Flow Controller

Roughing Valve

(1) Precurser Delivey Lines

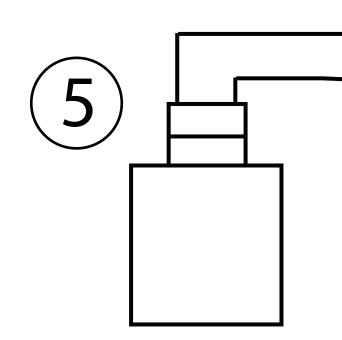
- 2 Carrier Gas Delivery Line
- **Substrate**

Throttle Valve

(4) Exhaust Line

(3) Water Cooler

(5) Vacuum Dry Pump



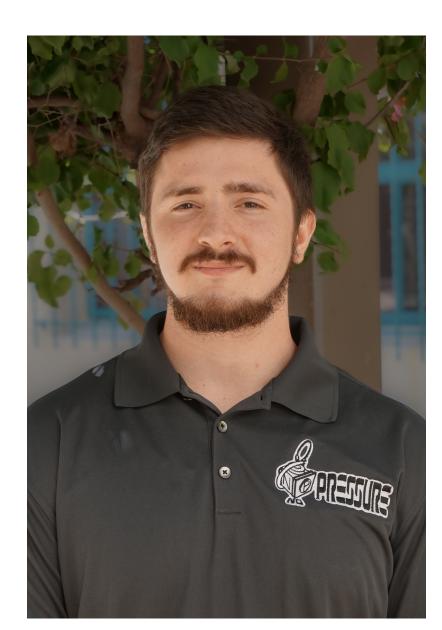
Team Members



PJ Thomas -Project Team Lead



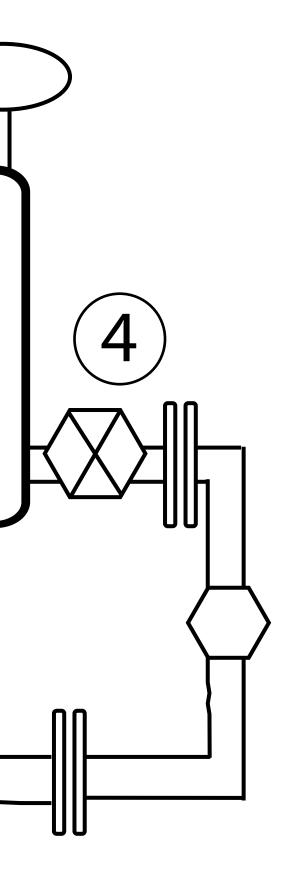
Devin Seyfarth -Testing Lead



Norman Stone -**Analysis Lead**

Chemical Vapor Deposition Team : No Pressure

Sponsored by: San Diego State University



- The Gen 1 oCVD Reactor uses a solid oxidant and liquid monomer. The solid oxidant is placed inside of a crucible loacted at the bottom of the reaction chamber. The oxidant vapor travels vertically toward the substrate, which is located at the top of the interior chamber.
- The Gen 2 oCVD Reactor switched from using a solid oxidant to a liquid oxidant. The oxidant is now located on the side along with the monomer.
- The Gen 3 oCVD Reactor was created to optimize the deposition rate of the reactor by reducing its overall volume.





1st Generation

Control Box

2nd Generation¹

The Pancake-Shaped Reactor is used for initiative Chemical Vapor Deposition (iCVD). Unlike the oCVD reactors, a heated filament is used inside the chamber.



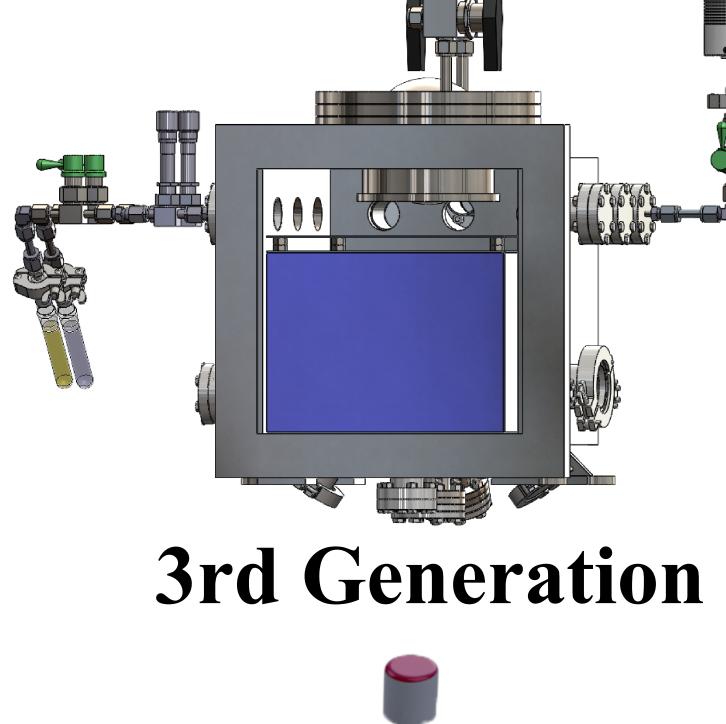
Ahmad Taleb -Manufacturing Lead

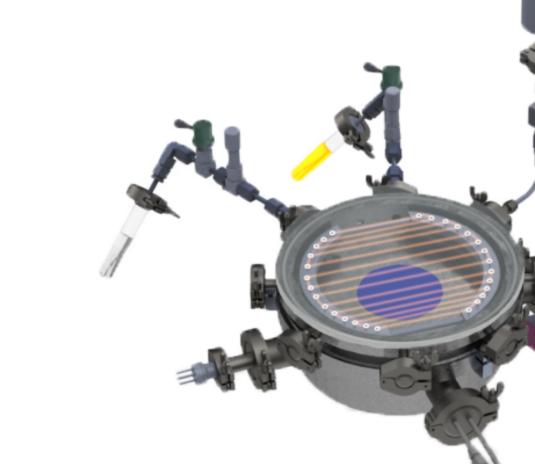


Final Design









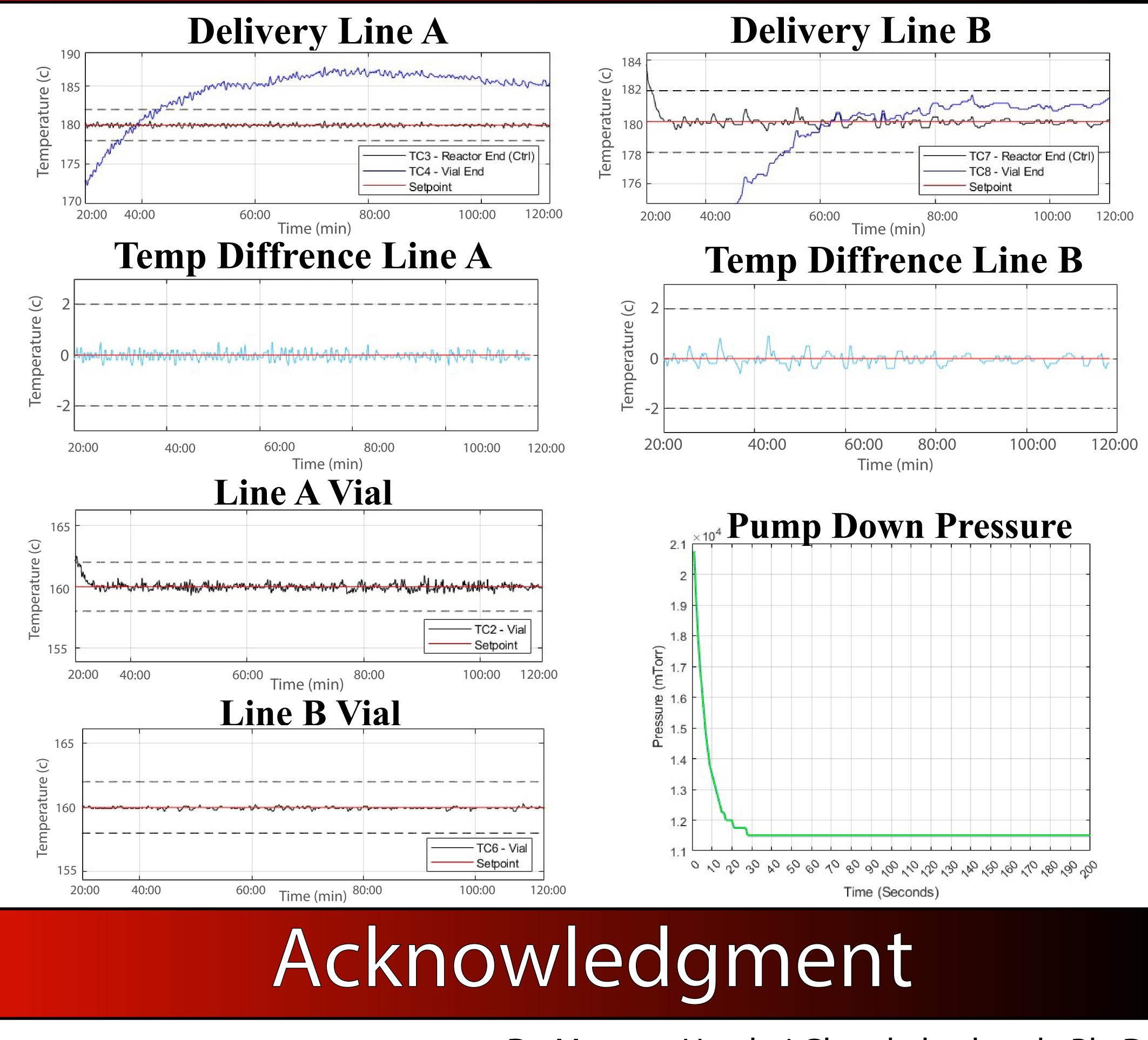
Pancake Reactor⁴

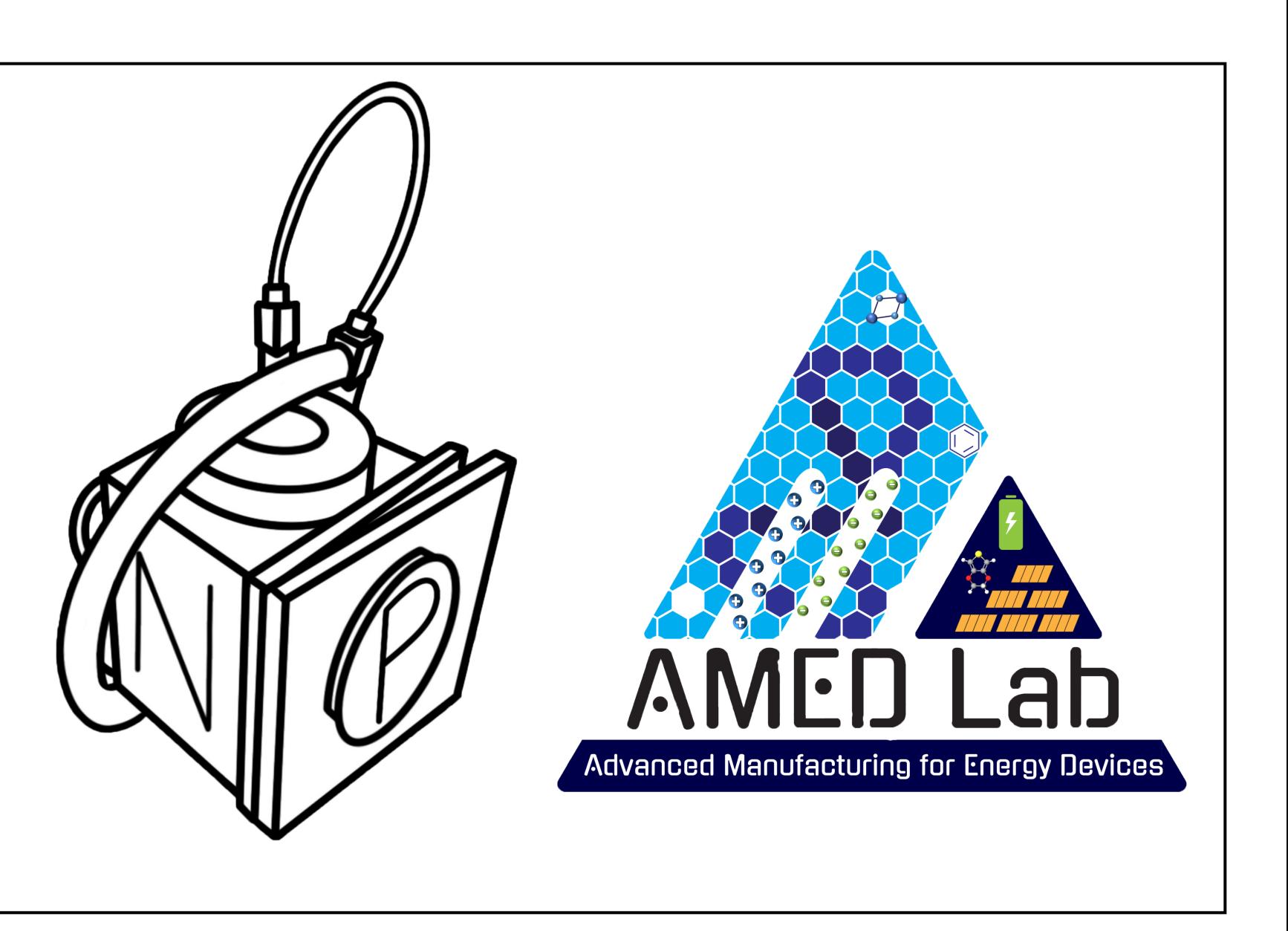
Chiller

Oil Pump

Throttle / Roughting Valves

Xenon Vacuum Guage





Results

The team would like to thank

- •Dr. Meysam Heydari Gharahcheshmeh, Ph. D
- the following for their assistance Dr Scott Shaffar, Ph.D
 - Mike Lester
 - Kafil Chowdhury
 - Previous Senior Design Group (Spring 2023)

Reference

- 1] Fig. 1. Schematic illustration of PEDOT synthesis by the oCVD method. (A) The postdeposition acidic rinsing step (e.g., MeOH or HBr rinsing) is generally used for poly(3,4-ethylene dioxythiophene) (PEDOT) films grown using FeCl 3 as an oxidant to remove unreacted oxidants and oxidation by-products and increasing conductivity. (B) Synthesizing PEDOT using VOCl 3 as an oxidant does not require the acidic rinsing treatment, and the fabricated film is directly used in device fabrication as a true single-step, all-dry process.
- 2] Figure 1: CVD Chamber Full Assembly Visual. Adapted from Anderson, C., Beck, J., Fahr, S., Perez, M., Schmid, T., & Lehman, A. 2023). 'Chemical Vapor Deposition for Depositing Thin Film Conductive Polymers. San **Diego State University, Mechanical Engineering Department.**