Chemical Vapor Deposition

Team : No Pressure

SAN DIEGO STATE UNIVERSITY

Sponsored by: San Diego State University

AMED Lab
Advanced Manufacturing for Energy Devices

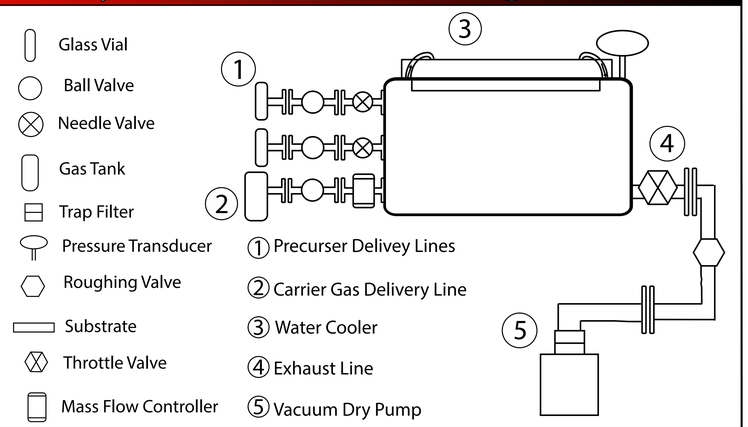
Project Description

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

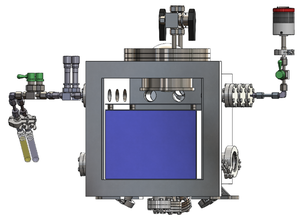


Final Design

- **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.

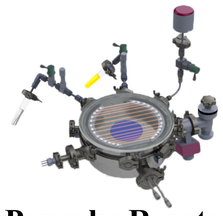
1st Generation [1]

2nd Generation [1]



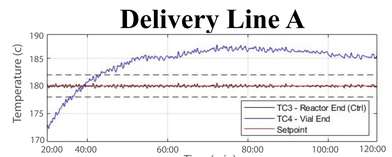
3rd Generation

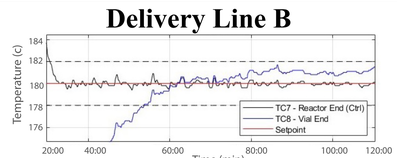
The Pancake-Shaped Reactor is used for initiative Chemical Vapor Deposition (iCVD). Unlike the oCVD reactors, a heated filament is used inside the chamber.

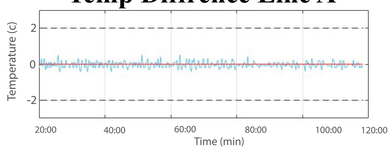


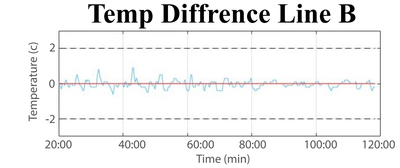
Pancake Reactor [2]

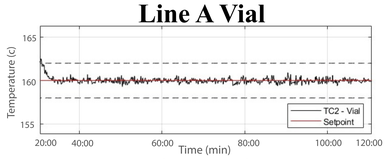
Results

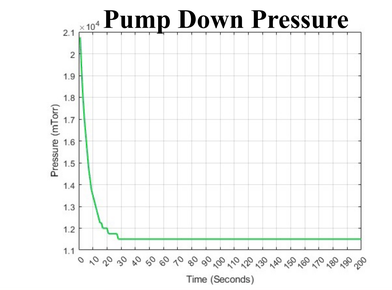


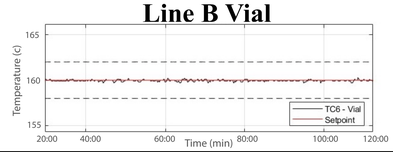












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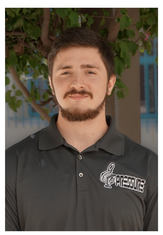
- Dr Scott Shaffar, Ph.D
- Mike Lester
- Kafil Chowdhury
- Previous Senior Design Group (Spring 2023)

Team Members

PJ Thomas - Project Team Lead

Devin Seyfarth - Testing Lead



Norman Stone - Analysis Lead

Ahmad Taleb - Manufacturing Lead

Main Components

Control Box

Delivery Line

Chiller

Oil Pump

Throttle / Roughting Valves

Xenon Vacuum Guage

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.

Spring 2024