Design of a Compact Pressure Sensor for Multi-Layer Insulation

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Aim: To design and implement a compact pressure sensor to measure the interstitial vacuum pressure between layers of Multi-Layer Insulation (MLI).

Background

- Multi-Layer Insulation is a thermal insulation system used to protect instrumentation on spacecraft and against boil-off of cryogenic fluids
- The pressure MLI is measured to determine if gaseous conduction and convection heat transfer become significant.
- Problematic Phenomena in Space
  - Cold Welding
  - Material Out-Gassing

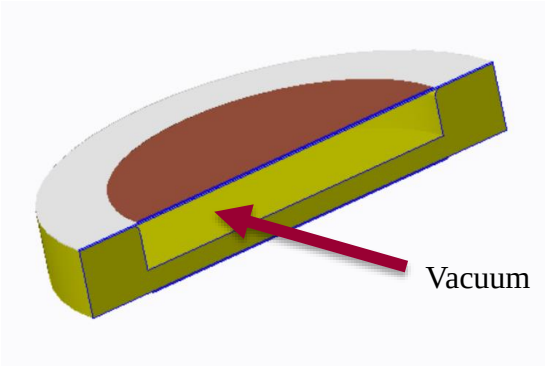
Objectives

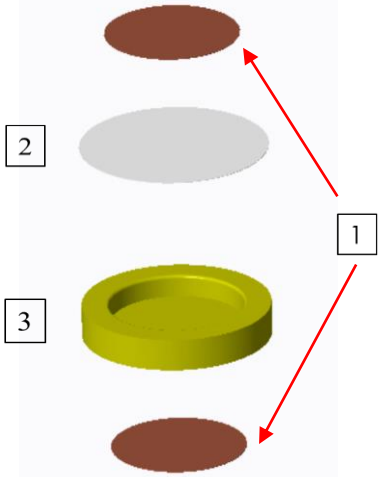
- Design a pressure sensor with minimal moving parts
- Minimize wiring and power consumption of the pressure sensor
- Minimize heat produced by the sensor

Future Work

- Finish testing under vacuum conditions
- Perform Stress Analyses / Run Simulations

Capacitor Design





Design Constraints

- Must read a minimum pressure of 10^{-2} Pa
- Must read one sample per second
- Should be minimally invasive to the MLI
- Sensor must be able to work in space

Design Components

1. Capacitance Tracts
   - Palladium – Gold Sputtered
2. 2. Silicone Diaphragm
   - 125 μm diameter
   - 25 μm thickness
3. Capacitor Base Shell
   - Germanium doped Silica
   - Acidic Etched cavity

Prototype Design

Base plate mold for the prototype is 3D printed using HIPS filament. BP is constructed using epoxy. Capacitors are the same material. Prototype is scaled by a factor of 25