Compact Pressure Sensing Device for Measuring Multi-Layer Insulation (MLI) Interstitial Vacuum – Team 11

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Project Scope

The goal of this project is to create a compact pressure sensor that measures from atmospheric pressure to vacuum pressures. This pressure sensor will be able to fit within the layers of a multi-layer insulation (MLI) to verify that the vacuum pressure within the layers is equivalent to the vacuum within the entire chamber.

Background

- NASA-MSFC wraps their cryogenic propellant tanks with a multi-layer insulation of alternating Double-Aluminized Mylar (DAM) and Dacron spacers.
- The MLI is used, while the propellant tank is at vacuum pressures, to protect the liquid hydrogen or oxygen propellants from being boiled off due to the heat from radiation.
- Any residual gas between the layers of the MLI allows for conduction and convection to cause more of the propellant to be boiled off.

Project Constraints

1. Measure from 760 torr to 0.0001 torr.
2. Operate at temperatures as low as 77K.
3. Sample at least once every second.
4. Avoid interference with MLI components.

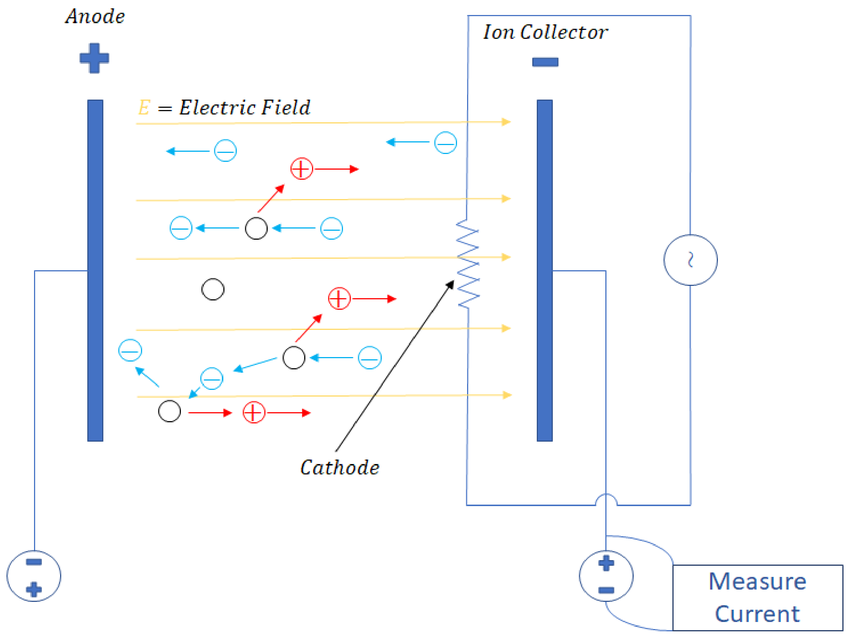

Figure 1: Schematic of Ion Filament Design.

Figure 2: Cryogenic propellant tank at MSFC.

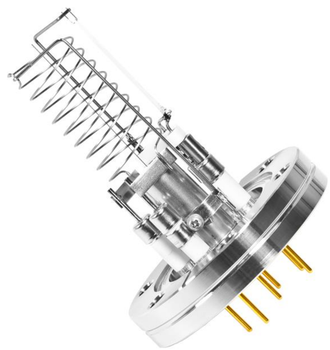

Figure 3: Standard Industry Ion Gauge.

Operation

- Stream of electrons emitted from cathode.
- If there is gas present, electrons will strike molecules and knock out electrons, creating a larger current.
- Pressure is proportional to the amount of gas present.

Why Ion Filament Was Selected

- The ion filament sensor works at extreme vacuum pressures up to 10^-3 torr. It does not work at higher pressures, so a second sensor might be needed.
- There is no mechanical dependency on strain that could be interrupted by temperature changes.
- Additional benefits include minute size, high sampling rate, and high resolution.

Future Work

Physical Design
- Design physical ion gauge.
- Perform prototype testing.
- Perform wire calibration.
- Ensure Voltage/Current Output.

Software Design
- Begin LabView program construction.
- Examine its functionality during sensor operation.
- Perform pressure output calibration.

Acknowledgements

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