



Design of a Compact Pressure Sensor for Multi-Layer Insulation



Team 15: Sebastian Bellini, Jason Carvalho, Stephen Johnson, Michael Kiefer Sponsor: James Jim Martin (NASA Marshall Space and Flight Center) Faculty Advisor: Dr. Wei Guo

Project Scope

The goal of this project is to design and implement a compact pressure sensor that can fit between the layers of Multi-Layer Insulation (MLI) and measure minute changes in pressure.

Background

- Multi-Layer Insulation is a thermal insulation system used to protect instrumentation on spacecraft, satellites and probes and to store cryogenic propellants.
- The pressure between slots/holes in the spacer and between metallic layers (the “interstitial region”) is measured to determine if gaseous conduction and convection heat transfer become significant.
- Working Conditions
 - ❖ Cold Welding
 - ❖ Out gassing

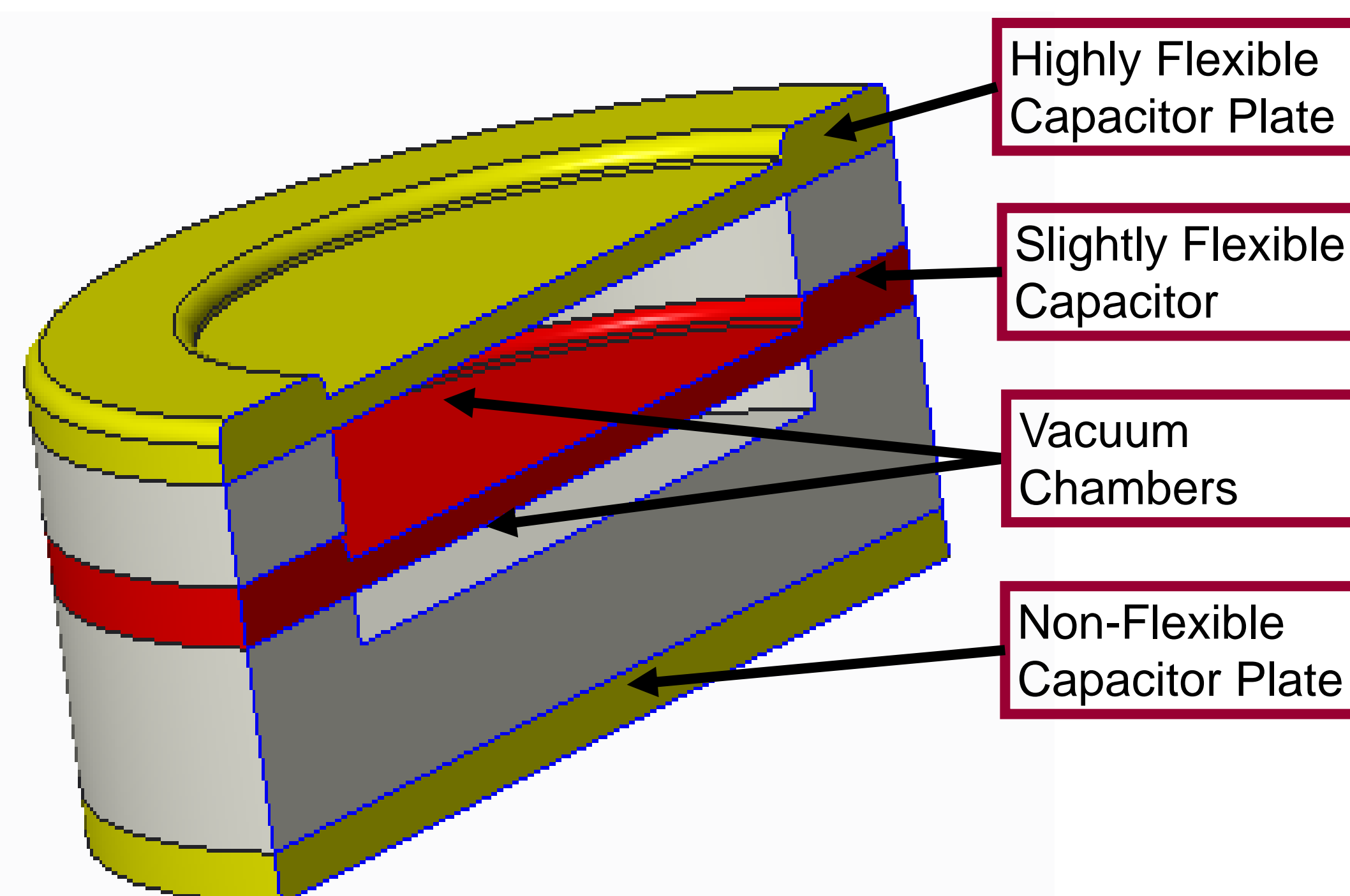
Objectives

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

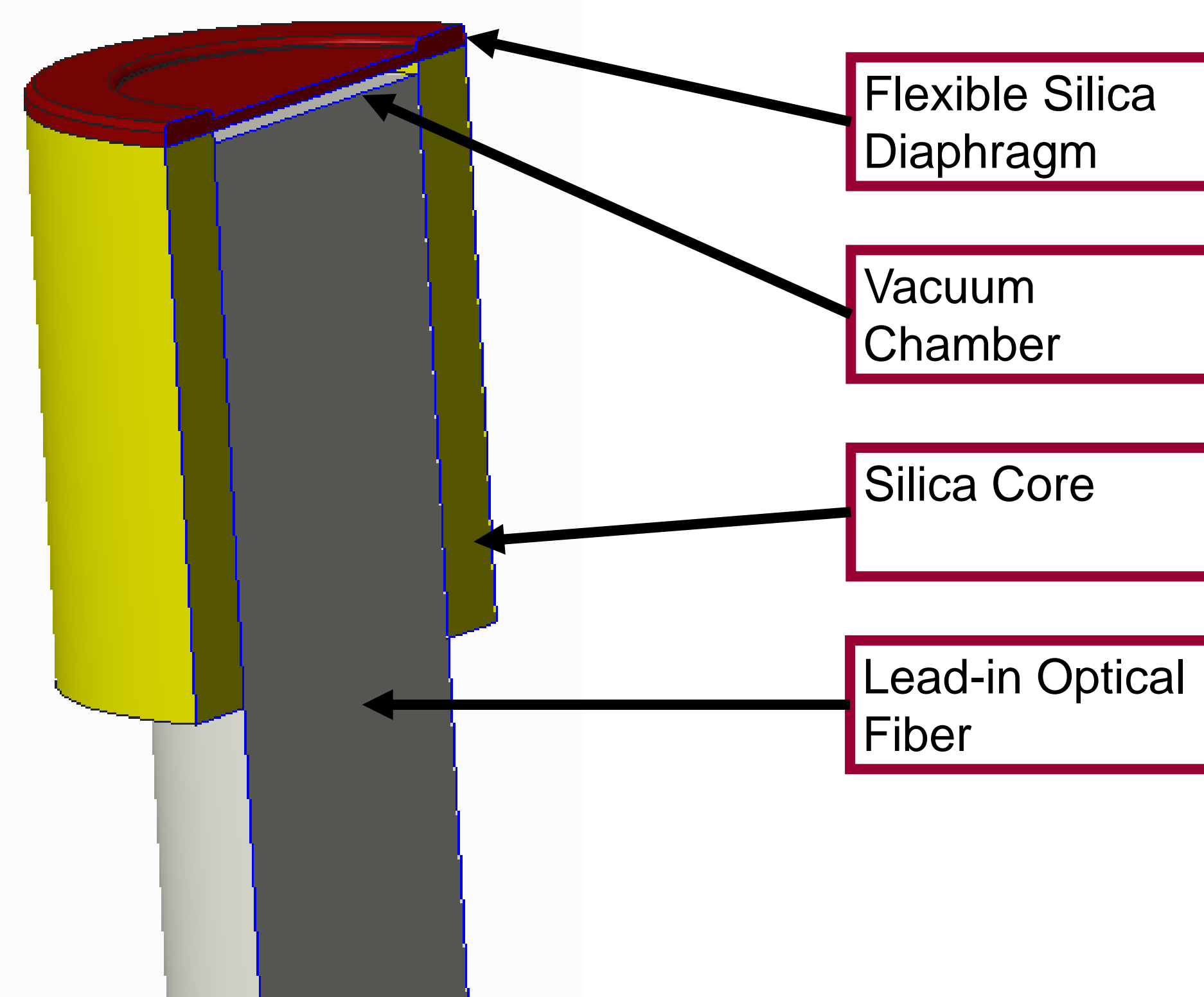
Constraints

- Must read a minimum of 10^{-2} Pa
- Must read one sample per second
- Minimally invasive to the MLI
- Be able to work in space

Multi-Stage Capacitor Design



Fiber Optics Design



Challenges

- Determining the distance between capacitor plates in multi-stage capacitor.
- Locating and negotiating with a nano-manufacture capable of producing our capacitor design at an affordable price.

Future Work

- Construction and analysis of an FMEA
- Locate and purchase manufacture for both designs
- Design a circuit, with minimal wiring, for both designs
- Calibration of both sensors
- Performance testing under vacuum conditions
- Evaluation of both designs

Acknowledgements

We would like to thank James Martin for his continued assistance throughout the project. His timely responses have helped us proceed in a quickly manner. We would also like to thank Dr. Wei Guo for his guidance throughout the brainstorming process and the following steps.

Reference

Ashrafi, Ashkan. *Research Gate*. Research Gate, Aug. 1999. Web.

"Multi layer insulation, multilayer films for MLI insulation - Dunmore corporation