A Real-Time Parylene Thickness Monitoring Optical Sensor System

Case # gsc14757-1

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Code 541

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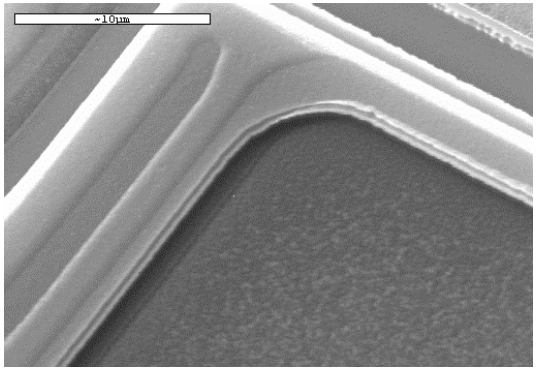
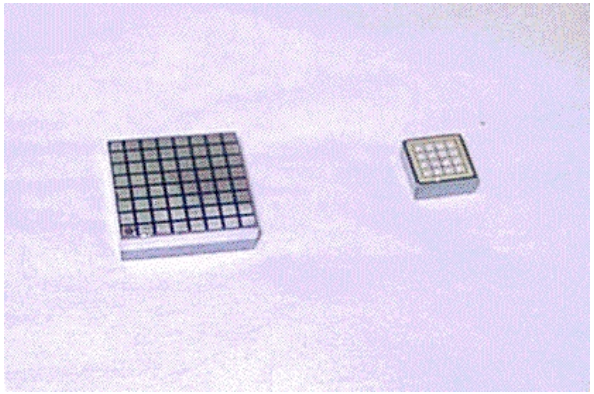
Enterprise

The sensor will support the advanced thin-film Parylene coating activities within GSFC including:

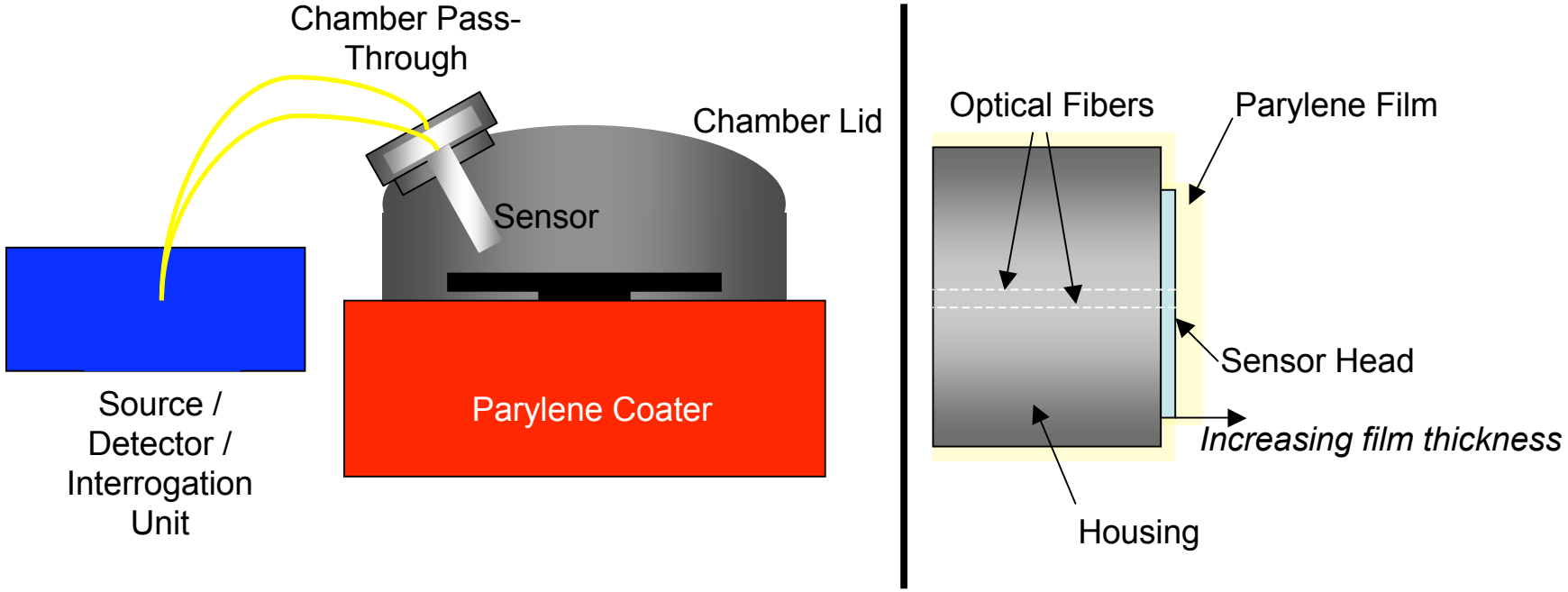
- •JWST/ISIM/Microshutters
  - – Lightshield Fabrication
- •HST/Satellite Service
  - – Parylene coating of thermal interface materials
- •EXIST
  - – Surface chemistry preservation of CZT detectors
- •IRAD Task: “Capability to Develop Prototype Nanopolymeric Materials for Planetary Balloons“





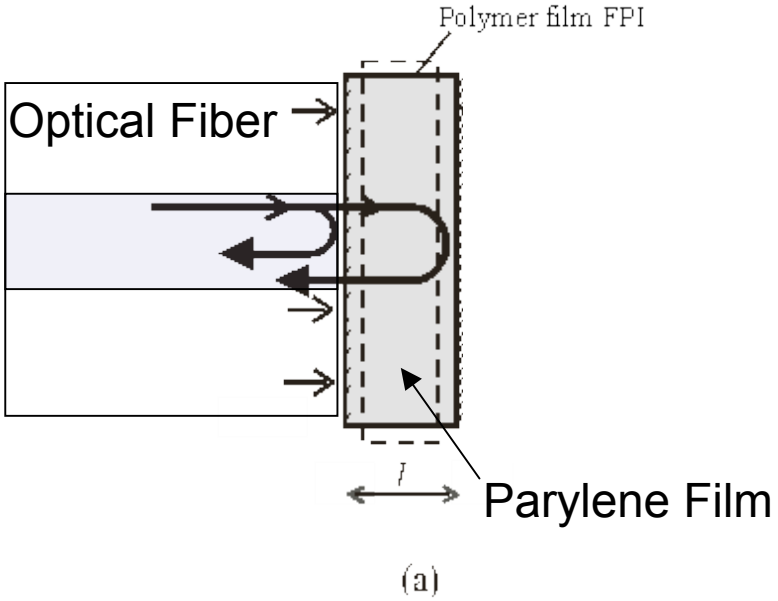
Sensor Overview

The sensor optically measures the increasing Parylene film thickness on the face of the sensor head. The polished face of the sensor head has 1 or more (2 shown) polished optical fibers. As the film deposits on the fibers, it creates a polymer Fabry-Perot cavity, which can be interrogated and measured. This measurement is directly correlated to the film thickness while maintaining a thermally identical coating surface as the hardware to be coated.

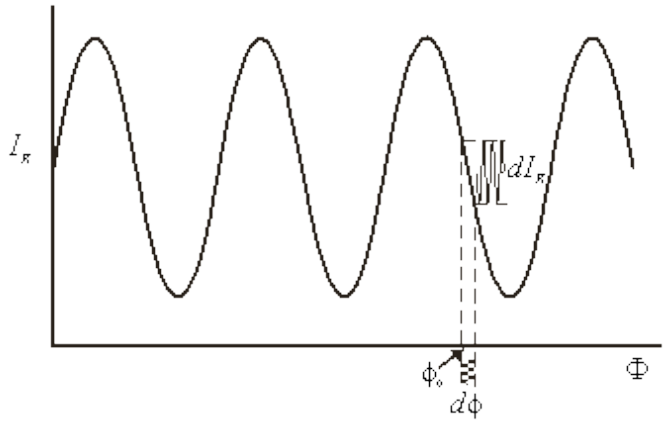


Basic Sensing Theory

•Back reflections will occur between the fiber/Parylene interface and the Parylene/"air" interface.
•The interference of these two signals (phase lag) will create fringes in the output spectrum.
•Fringe pattern is directly correlated to film thickness.



(a)



(b)

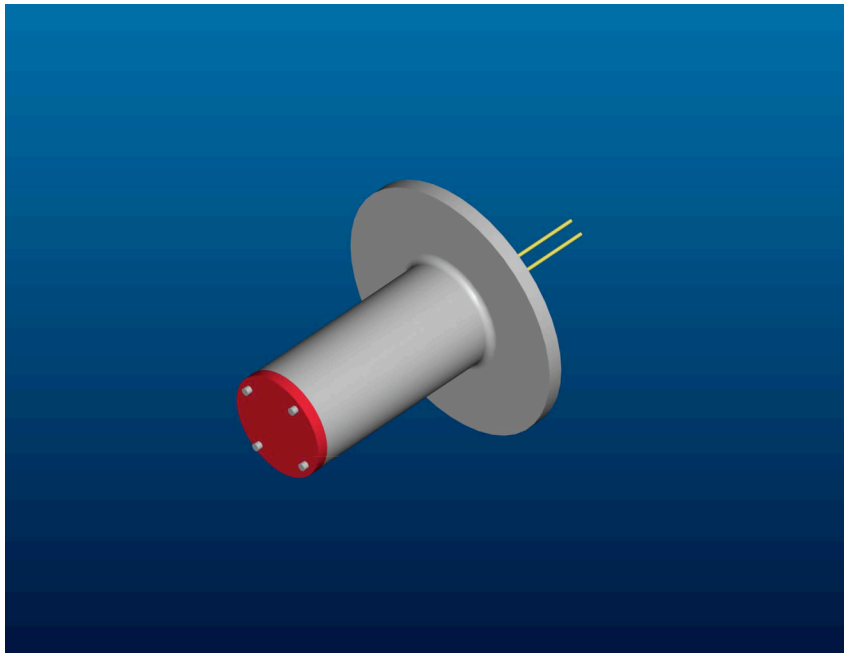
Motivation and Impact

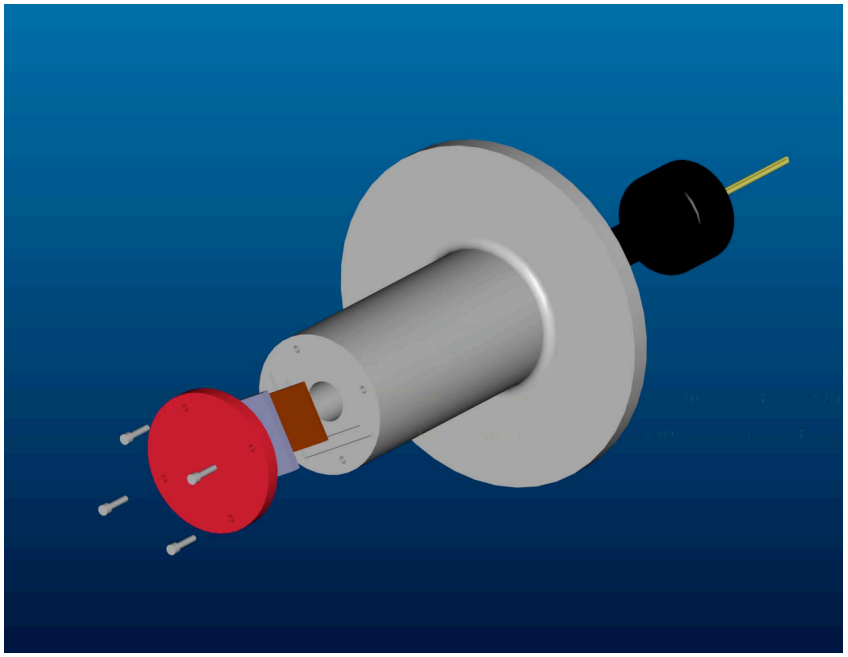
- Precise thin film depositions require precise measurement tools in real-time.
- Current thickness targets are reached by an approximate raw material to coating thickness ratio.
- This method is highly variable, and not suited for applications requiring critical thicknesses.
- An existing thickness sensor (U of Illinois) is an end-point thermal sensor. However, the deposition rate of Parylene is thermally dependant, reducing resolution.
- Advanced applications of thin film Parylene are limited by the precision of the deposition.
- Enhanced thickness monitoring and deposition can enable the advancement of existing technologies, and act as a facilitator for new applications of this material.
- Direct impact to GSFC projects by enabling precise film deposition.

Breakout of Cost

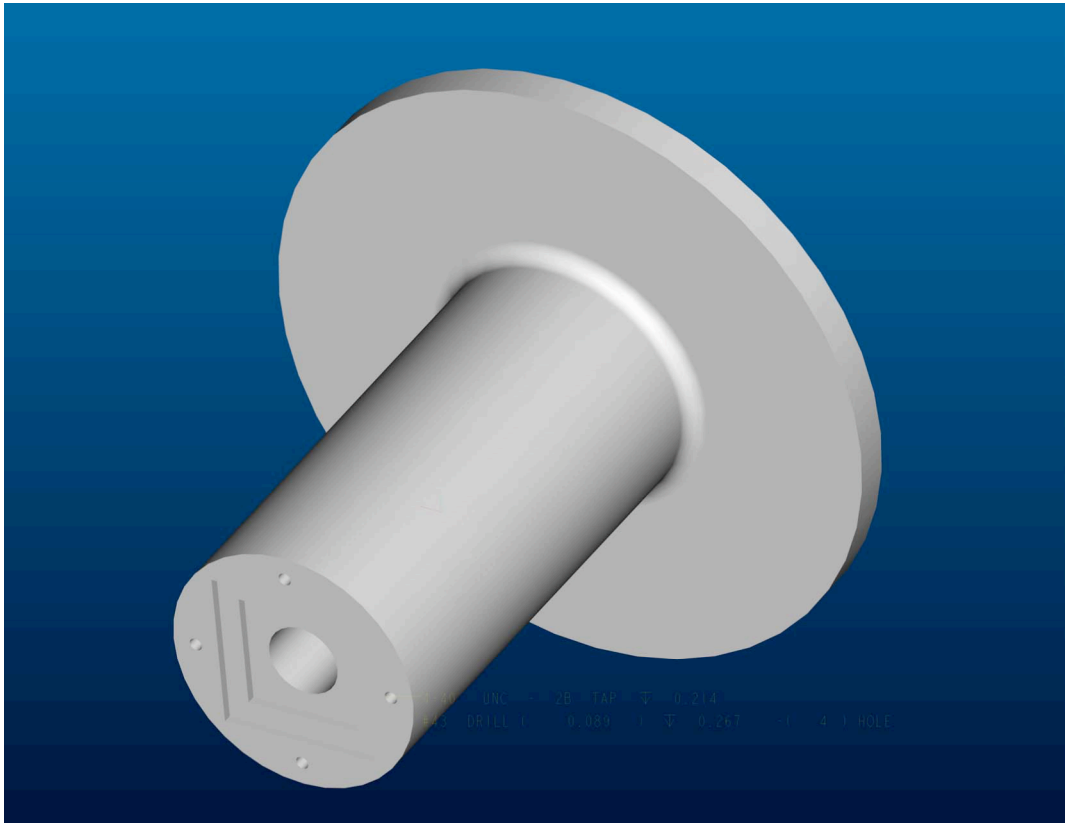
Parts	
Machined Parts	$700
Fused Silica Plates	$200
Fiber Optic Patchcords/Couplers	$700
Source/Detectors/Electronics	$5K
Miscellaneous Parts/Machining	$1K
Labor	
Swales Support	$1K
Civil Servant Support (541/562)	--
TOTAL	$8.6K

Assembled and Exploded Sensor Layout





Sensor Housing



SUPPLIER:

Eagle Machining LLC.

20 E High St

New Freedom, PA 17349

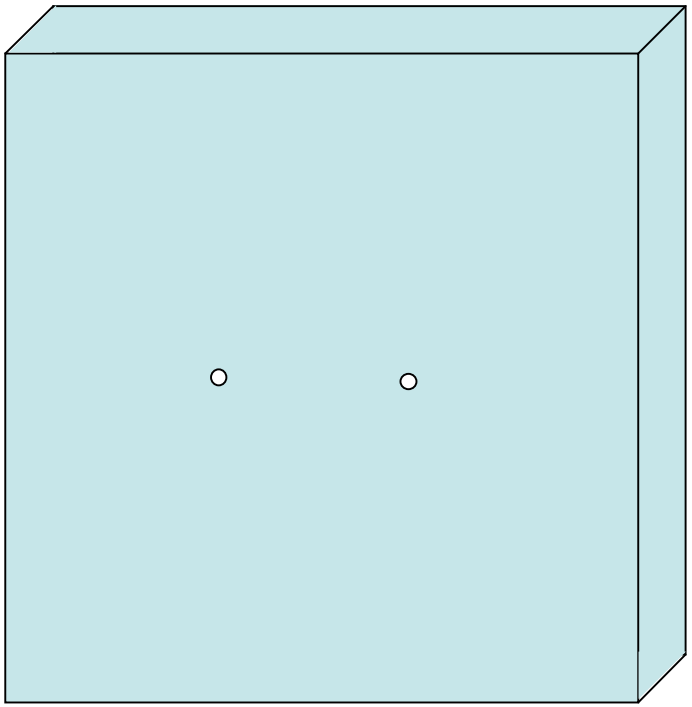
COST:

QTY: 1 $300

*QTY: 3 $125/ea

QTY: 50 $81.22/ea

Fused Silica Face Plate



1” Square x 1/8” Thick Fused Silica

Same polish rate as optical fibers

Laser Drilled 130 holes

Fibers fused into plate, polished/cleaved

Supplier:

*Edmund Scientific (TBD)

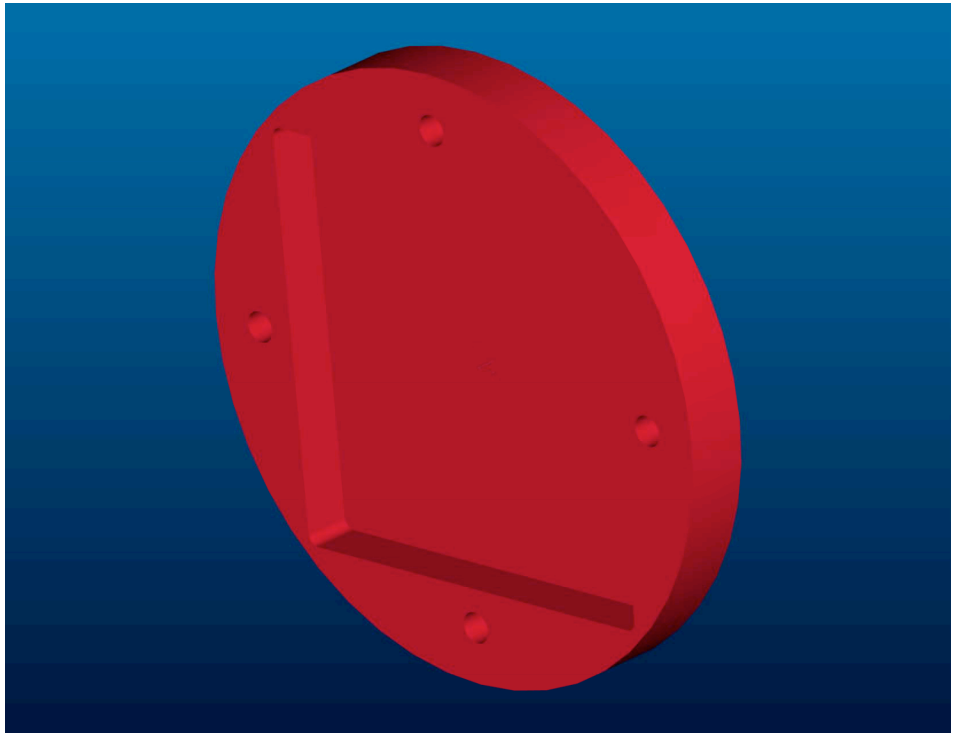
Pricing: ~$50 each

Machining:

*UMD or APL

** Denotes potential supplier, TBD*

Sensor Cap



End cap to protect sensor head.

Attaches with 4, #4-40 screws

Accessory item, not required for product development.

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