Thermally Insensitive Silicon Carbide Optical Telescope Payload for High Performance Small Satellite Relevant Space Environments

Trent Newsom*, Matt Felt*, Jim Peterson*, Hugo Vargas*, allspace Dynamics Laboratory, USU Research Foundation, b) POCO Graphite, Entegris

1 Abstract
Small satellite buses offer an economical platform for optical payload. However, the smaller buses struggle to provide the thermal stability that high performance optical payloads typically require. Thermal modeling can be performed through thermal modeling software and active thermal control systems, but these add additional costs and complexity. An economical and lightweight alternative often considered for small satellites is the high thermal stability and lightweight of graphite. This study considered graphite; however, the high thermal expansion of graphite requires an additional heat spreader to maintain optical performance and requires additional volume, mass, and power; or by decreasing the optical instrument's sensitivity to thermal control requiring additional volume, mass, and power, which only decreases the optical performance. The goal of this study is to provide an optimal material for a small satellite to maintain optical performance and allow for in-space assembly and alignment while minimizing thermal variation sensitivity. The material selection for a small satellite high-performance optical payload is evaluated using its manufacturing, integration, and assembly requirements. The material selection is to develop an optical telescope design for a small satellite that maximizes optical aperture and imaging performance while minimizing thermal variation sensitivity. The material trades evaluated the pro and cons of graphite converted beta-phase silicon carbide (SiC) due to its high thermal dimensional stability and its ability to maintain good optical performance.

2 Problem
Small satellite buses struggle to provide the thermal stability that high performance optical payloads require.

3 Optical Design
The On-Board Celestial Lightguides (OCLC) Telescope

4 Material Trades

5 Optical Performance

6 Material Selection

7 Layout

8 Results

9 Conclusions

10 6U Thermal Analysis

11 SCA Thermal Analysis

12 OCA Layout

13 Interchangeability: Rapid Mission Flexibility

14 Conclusion