Cryothermal Measurements of Variable Emittance Coatings

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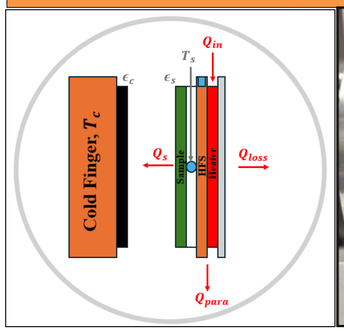
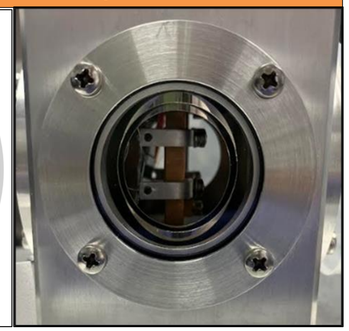
Abstract

The purpose of this experiment is to determine how a variable emittance coating behaves in a cold space environment with variable internal heating, as well as how tungsten doping affects its performance with lower phase transition temperature ranges. The results of this experiment will show how a variable emittance coating performs under cryostat testing conditions in order to determine its radiative cooling properties. By optimizing the performance of radiative cooling materials, energy originally used to provide thermal control can be preserved.

Sample Setup



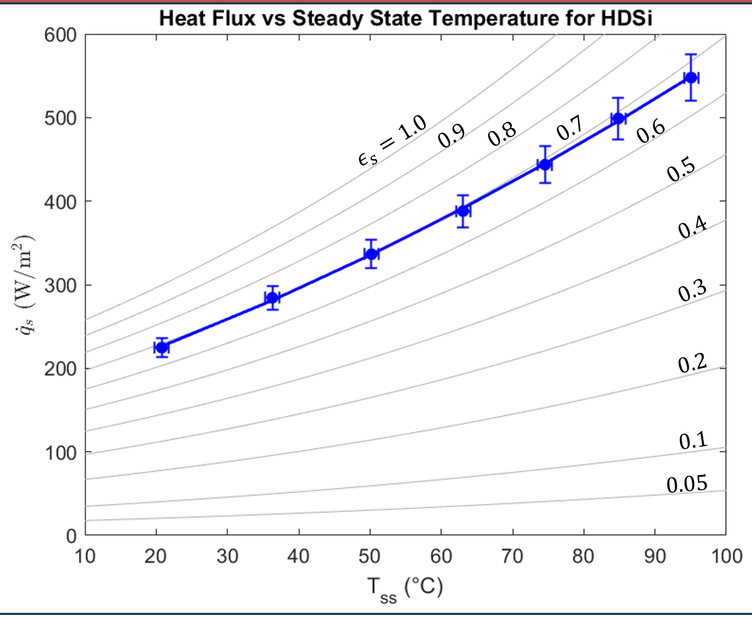


Experimental Setup

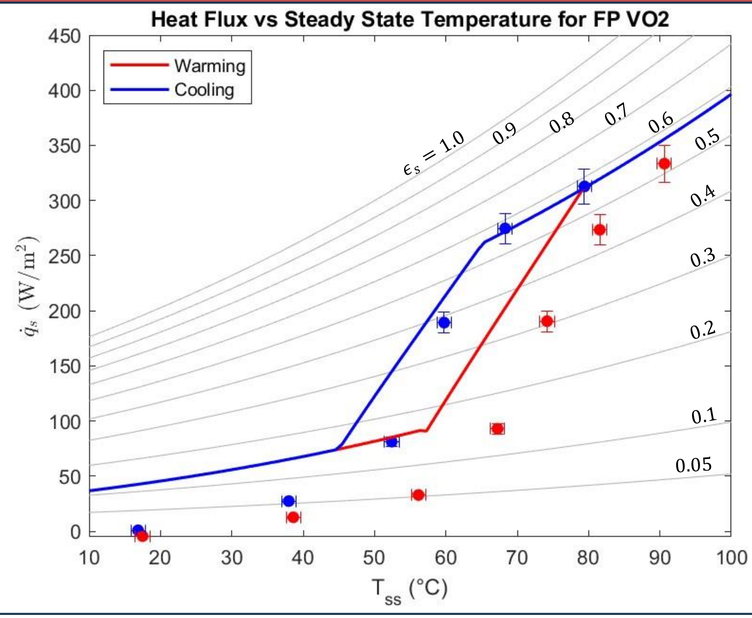
The cryostat replicates the environment of space, providing a high-vacuum, and cryogenic temperatures around 80K. The heater mimics internal heating from the spacecraft.

Sample Heat Flux

Highly Doped Silicon



Variable Emissivity Coating (FP VO2)



Objectives

- Measure the emissivity and thermal properties of common spacecraft materials to compare to variable emissivity coatings.
- Demonstrate improved phase range temperatures for variable emissivity coatings.
- Evaluate thermal homeostasis properties by comparing a sample with black backing to one with aluminum backing.
- Update experiment apparatus.

Results

- Used black acktar and tungsten/Si to calibrate, then verified results using HDSi and LDSi, which have known emissivity values.
- Applied calibration to VO2 sample, which demonstrated theorized emissivity changes.
- Replicated experiment using black backing instead of aluminum and collected data for future analysis.

Future Work

The next steps are to test 1%, 2%, and 3% doped Silicon samples to show how the phase range temperatures change, as well as apply optical heating to simulate heating by sunlight. There are also some improvements to be made to the sample apparatus in order to have a more accurate view factor.

Acknowledgements

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