Spacecraft Thermal Management 2018 - 2019

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Project Background

Low earth orbiting spacecraft are subjected to heavy thermal loads due to constantly changing fluxes from the Earth's biggest heat source, the sun. Hardware on such a satellite must operate in a range larger than the ranges of temperatures found on Earth.

For smaller satellites, mechanical hardware may prove too uneconomical and unreliable for use in space. A promising solution for a space shield is to use a variable electrochromic radiator to attract and reflect heat fluxes on these satellites. Current on the market radiators from companies like Ashwin Ushas Corp are expensive to purchase.

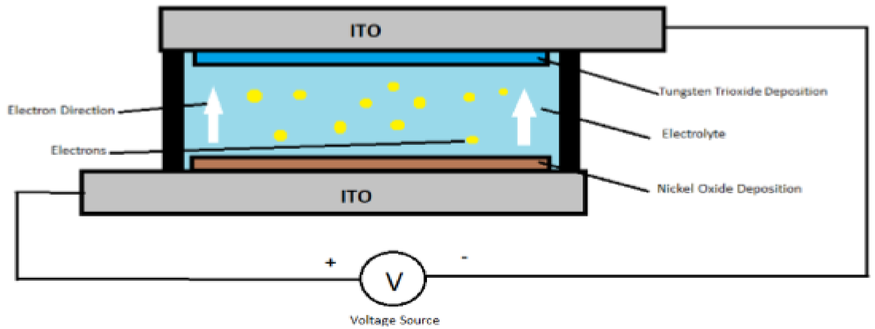


Figure 1: Schematic Of Variable Electrochromic Device Prototype

Figure 2: Proof Of Concept Assembly Experiment

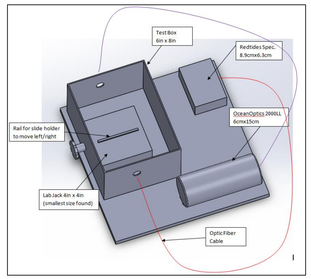


Figure 3: Overview of Mass Spectrometer for Film Testing

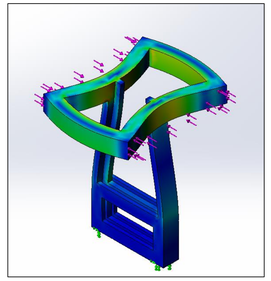


Figure 4: Simulation of component made for Redox Film Testing

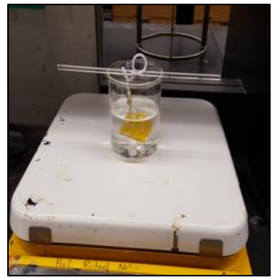


Figure 5: Chemical Slide Undergoing CBD Process

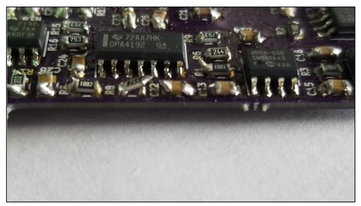
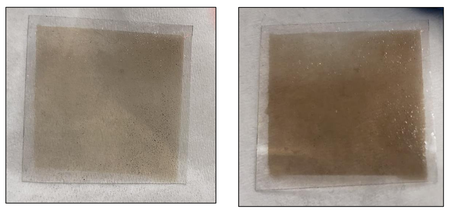
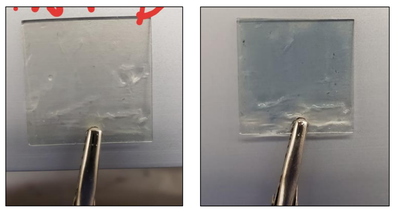


Figure 6: Potentiostat Undergoing Repair and Reprogramming



Figures 7 (Left) & 8 (Right): Nickel Slides Bleached (Left) and Darkened (Right) at 1.5 Volts



Figures 8 (Left) & 9 (Right): Tungsten Slides Bleached (Left) and Darkened (Right) at 1.75 Volts

Goals

Design, manufacture, and test a low cost, variable electrochromic thin film prototype by Summer 2019 for use on Cube, Nano and other budget satellites.

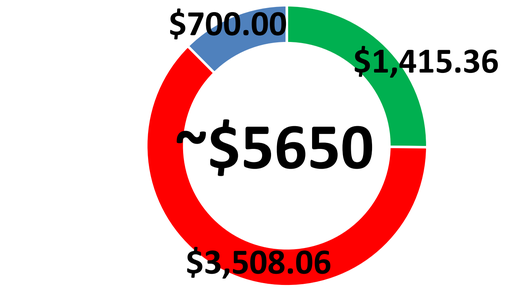
Objectives

Cost: <$125 per sq. inch
Operating Conditions: < 10E-5Pa
Weight: ~1.25kg per sq. meter
Emissivity: Variable from ε = 0.2 - 0.8
Max Power: 3 VDC
Thermal Barrier: 332-379K

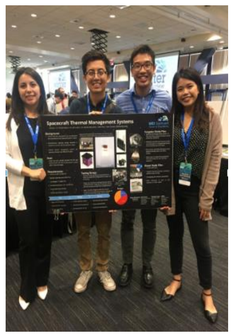
Timeline

Fall	Winter	Spring
• Design Proof of Concept Prototype • Finish Coding and Calibration of the Potentiostat • Begin Making Films through Chemical Bath Deposition • Begin Redox Reaction Testing of Chemical Films • Implement Spectrometer to Testing	• Manufacture Proof of Concept Prototype • Continue Making Films through CBD • Continue Spectrometer Testing • Continue Redox Reaction Testing of Films • Begin Redesign of Vacuum Chamber • Implement synthesis and annealing film processes	• Test Proof of Concept Prototype • Continue to Synthesize and Refine Procedures for Chemical Films • Continue Spectrometer Testing • Continue Redox Reaction Testing of Films • Test New Redesign of Vacuum Chamber

Team Budget



Last Year's Team



Team Organization