Spacecraft Thermal Management 2018 - 2019

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Project Background

- Spacecraft operate in a temperature range larger than the ranges found on Earth and must efficiently absorb/reject heat.
- For smaller satellites, mechanical hardware may prove too uneconomical and unreliable for use in space.
- A solution for a space shield is to use a variable electrochromic radiator to absorb and reject different amounts of heat.
- Similar to 787 windows, an electrical current is passed through slides and will emissivity changes almost instantaneously.
- Light Color (Sun): Reflect: ↑, Emissivity: ↓
- Dark Color (Dark): Reflect: ↓, Emissivity: ↑

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.

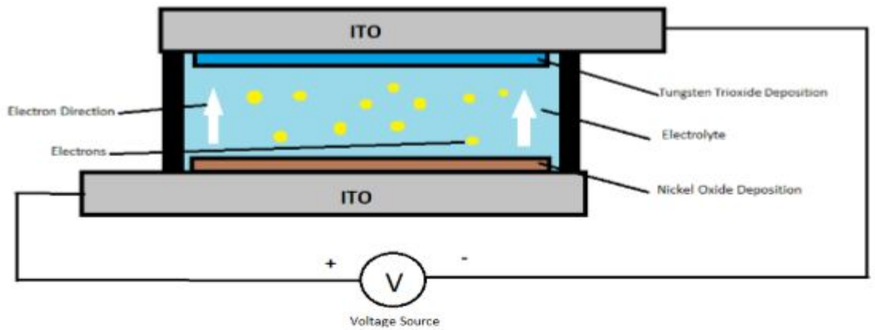


Figure 1: Schematic Of Variable Electrochromic Device Prototype

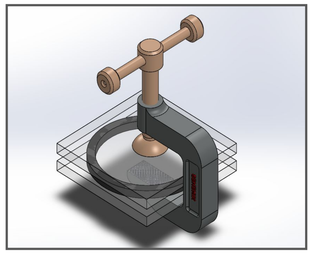


Figure 2: Proof Of Concept SolidWorks Model

Figure 2: Proof Of Concept Assembly Experiment

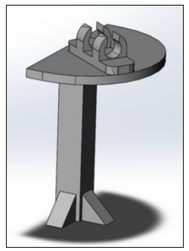


Figure 3: Lense Holder for Spectrometer Testing Station

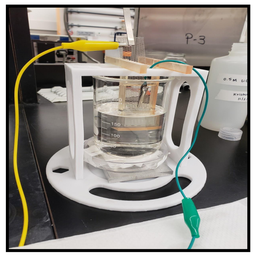


Figure 4: Testing Stand with Nickel and Platinum Electrode

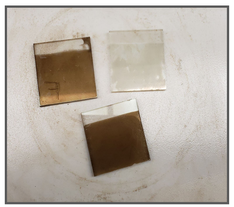
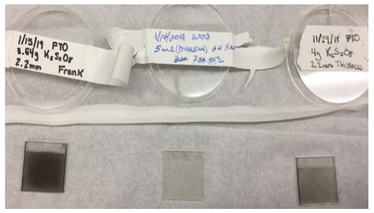


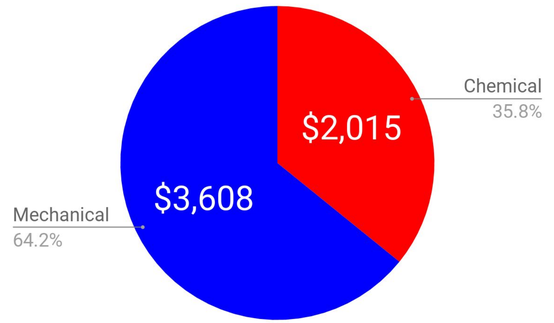
Figure 6: Nickel (dark) and Tungsten (white) slides

Figures 7 (Left) & 8 (Right): Nickel Slides Colored (Left) and Tungsten Slide Colored (Right)



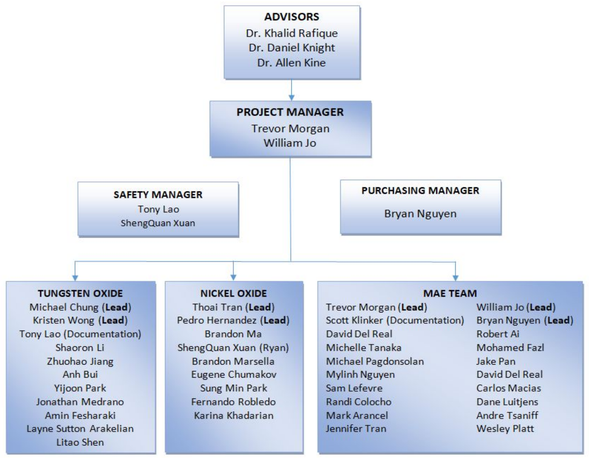
Figures 8: Slides before annealing

Team Budget



This Year's Team

Team Organization



Timeline

Fall

- 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

Winter

- 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

Spring

- 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

Objectives

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