Plasma Research Group

Christina Taft and Michiru Warren

CAL POLY

EP Plume paper and RPA Integration

- *EP Plume Electron Models using Experimental Data*
  - Data digitization, final verification and analysis in progress
  - Scitech conference abstract submitted
  - Future work – acquire additional plume data in STELLA and perform comparison with existing electron models
- *RPA Construction*
  - Design phase completed, including lit. review, CAD, and BOM generation
  - Components procured and assembled
  - Initial testing and validation in Thing 1
  - Future work – extended testing campaigns to validate experimental performance and improve measurement fidelity

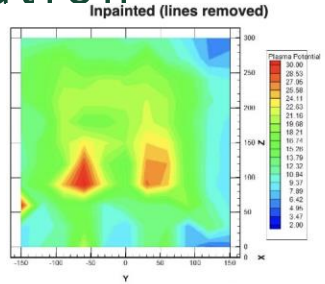
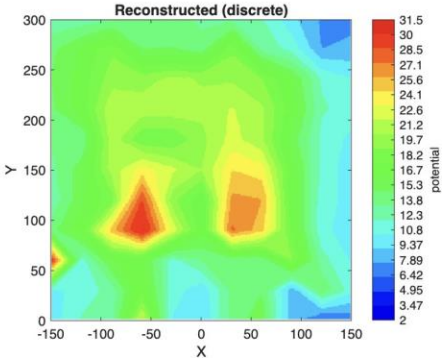


Figure 22: Plasma potential (volts) in front of thrusters 1 and 2.

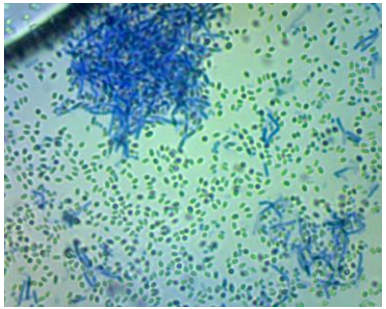


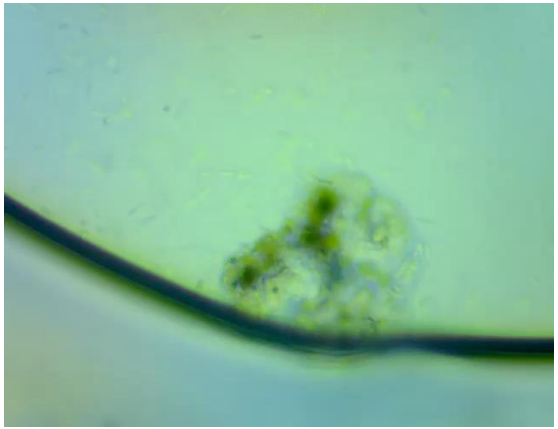
Data Digitization Example Result

Manufactured RPA

Personnel: Christina Taft, Jonathan Holly

Planetary Protection





- Developed independent protocols for culturing *Bacillus subtilis* and inducing endospore formation via nutrient-depletion.
- Confirmed sporulation using a modified Methylene Blue dye technique.
  - Blue Rods: Active vegetative bacteria that successfully absorbed the stain.
  - Refractive Green/Silver Grains: Mature, dormant endospores that resisted the dye, indicating a successful transition to the resilient spore state.
- Future Work:
  - Replicate bacterial growth using space materials such as Kapton polyimide film or Orthofabric
  - Study the impact of plasma environment on bacterial survival using a bell jar combined with an inductively-coupled RF-driven plasma source
  - Evaluate the decontamination potential of Plasma Activated Water (PAW) against both vegetative cells and resilient endospores

Personnel: Yellana Moulla, Cruz Segura

RF and Multi-Mode thruster

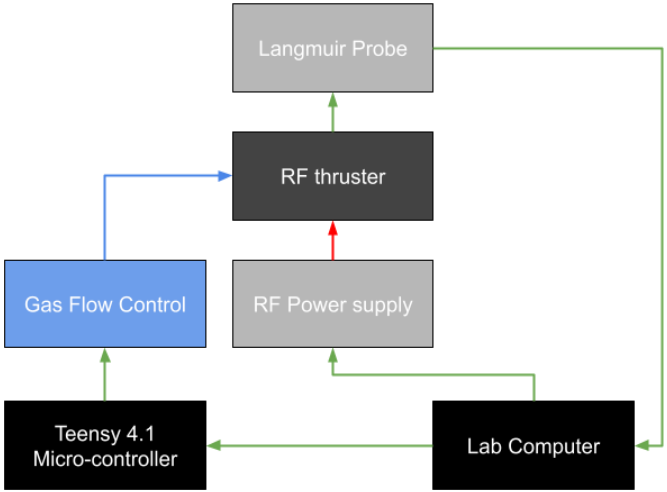


Fig. 8: Gas Flow and RF Power supply control via Lab Computer (waiting on supplies)

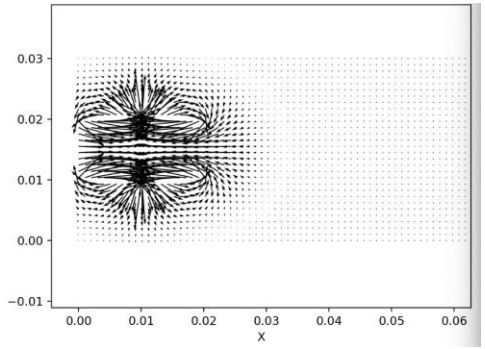


Fig. 9: HEMPt magnetic field model using Magpylib

Fig. 11: RF thruster and Langmuir probe with power supply

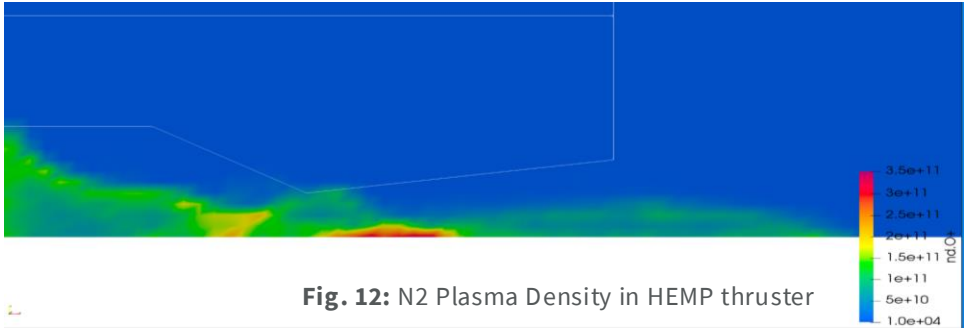


Fig. 12: N2 Plasma Density in HEMP thruster architecture with CD Nozzle using Starfish

Personnel: Trace Talbot , Tim Webb

Lunar Regolith Removal Project

- Lunar regolith is well known to be abrasive and sticky, leading to possible failures of optical and mechanical systems, as well as leading to respiratory irritation in humans
- Lunar habitats will lead to unique challenges and opportunities:
  - Despite the use of air locks, some regolith will be dragged in.
  - Spacesuits need to be periodically cleaned, impractical to carry multiple per astronaut
  - Pressurized environment and human presence provide opportunities to use methods not applicable to the external environment.
- Project objectives:
  1. Investigate applicability of cleanroom cleaning methods for removal of lunar regolith simulant from various representative surfaces
  2. Quantify method effectiveness and surface damage potential

Research funding provided by the California Space Grant Consortium. Results to be presented at 2027 AIAA SciTech.

- Future work to use laser diagnostics to study regolith dynamics in plasma environment

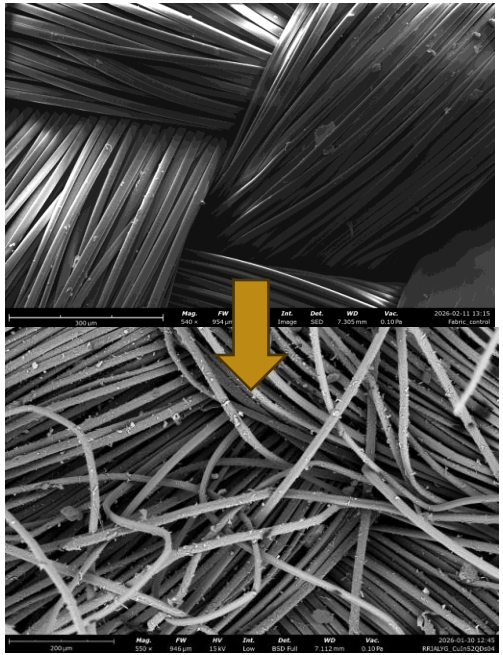


Fig. 1: Uncontaminated Ortho-Fabric and abrasively damaged Ortho-Fabric

Personnel: Sophia Kainz, Jack Schafer, Sohail Sharma, Michiru Warren

Regolith Isolation Analysis

Fig. 2: VisiClean ultrasonic cleaner that is used for this work.

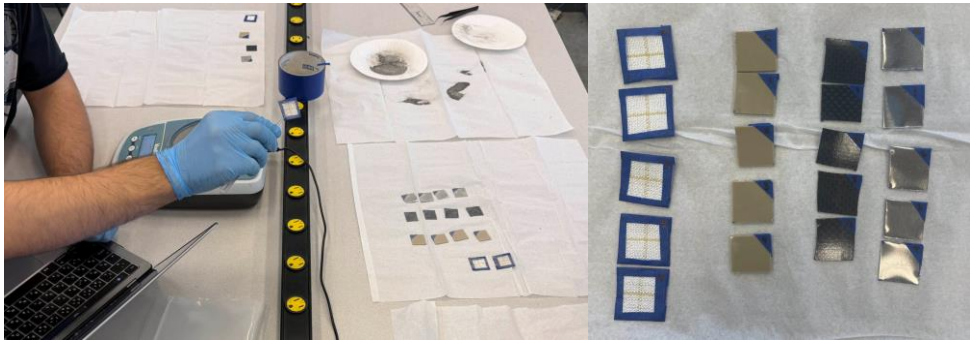


Fig.3: Material preparation in Cal Poly's Space Environments and Testing Laboratory (left) and prepared Ortho-Fabric, PEEK, carbon fiber, and aluminum samples (right).

Fig. 4: Image showing the process of aligning the images by line ROI

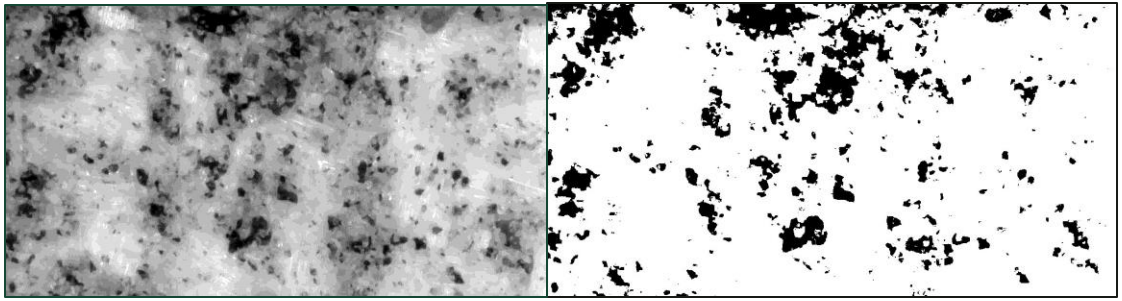


Fig. 5: Optical microscope images (left) and images processed in ImageJ (right) of a regolith-contaminated Ortho-Fabric sample cleaned with compressed air

SEM Image Analysis

Fig. 6: Gold sputtering non-conductive materials

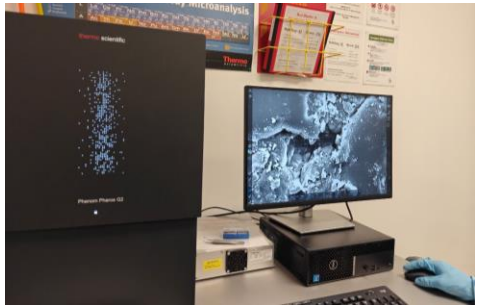
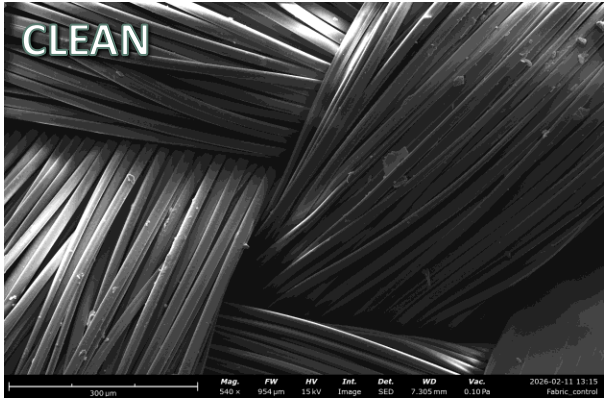


Fig. 7: Phenom Pharos G2 Scanning Electron Microscope



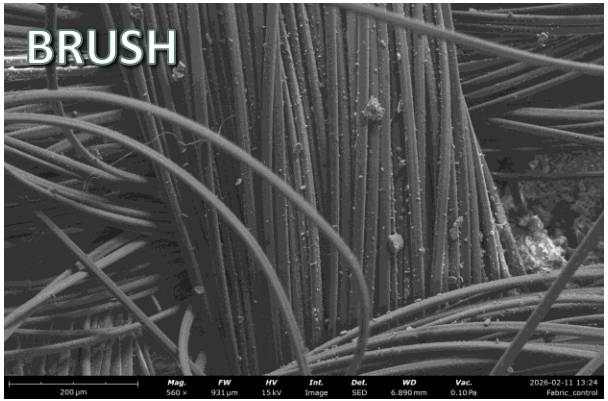


Fig. 8: Ortho-Fabric samples pre- and post-cleaning with various cleaning methods.

THANK YOU!