National Aeronautics and Space Administration

FY24 Strategic Initiatives Research and Technology Development (SRTD)

Solar Array Technology for Venus Cloud Environments

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Strategic Focus Area: Technologies for Venus Cloud Environments / Venus In-Situ Aerosol Measurement Technologies **|**
Strategic Initiative Leader: James A Cutts

Objectives:

Develop a solar array technology that survives and operates effectively in the clouds above Venus. Achieve > 20% efficiency, > 40 W/kg specific power and operate for > 100 Earth-days. Specific objectives for the third year of this task (FY24) included:

1) Demonstrate corrosion-resistance of protective encapsulants, specifically <25 μm corrosion after exposure to $2.0 \cdot 10^{-5}$ mg/cm^3 H_2SO_4 aerosols for 96 hours.

Background:

- Intended to enable long-duration exploration in the Venus atmosphere using a high-altitude balloon, or “aerobot”
- State-of-practice solar arrays would not survive in Venus’ sulfuric acid clouds.
- Survivable solar arrays for the Venus clouds can recharge a battery repeatably to greatly extend the mission.

Approach and Results

A test plan was generated with detailed procedures for testing a solar panel test article from FY22 and material samples, all with a protective coating for operation in the Venus cloud layer. The test plan includes procedures for inspection and performance measurements under illumination before environmental test, installation of the test articles in the Venus cloud test chamber, exposure to the simulated Venus cloud environment at the expected temperature, and inspection and performance measurements after environmental exposure.

Assistance was provided to the team assembling the Venus cloud simulation chamber. Assistance included maturation of the chamber design, shown in Figure 1, including completion of the chamber lid design.

A technology readiness assessment (TRA) was conducted to determine the current state of the solar array technology for the Venus clouds. The overall technology readiness level (TRL) was validated ats TRL-3, with the protective coating element validated at TRL-4.

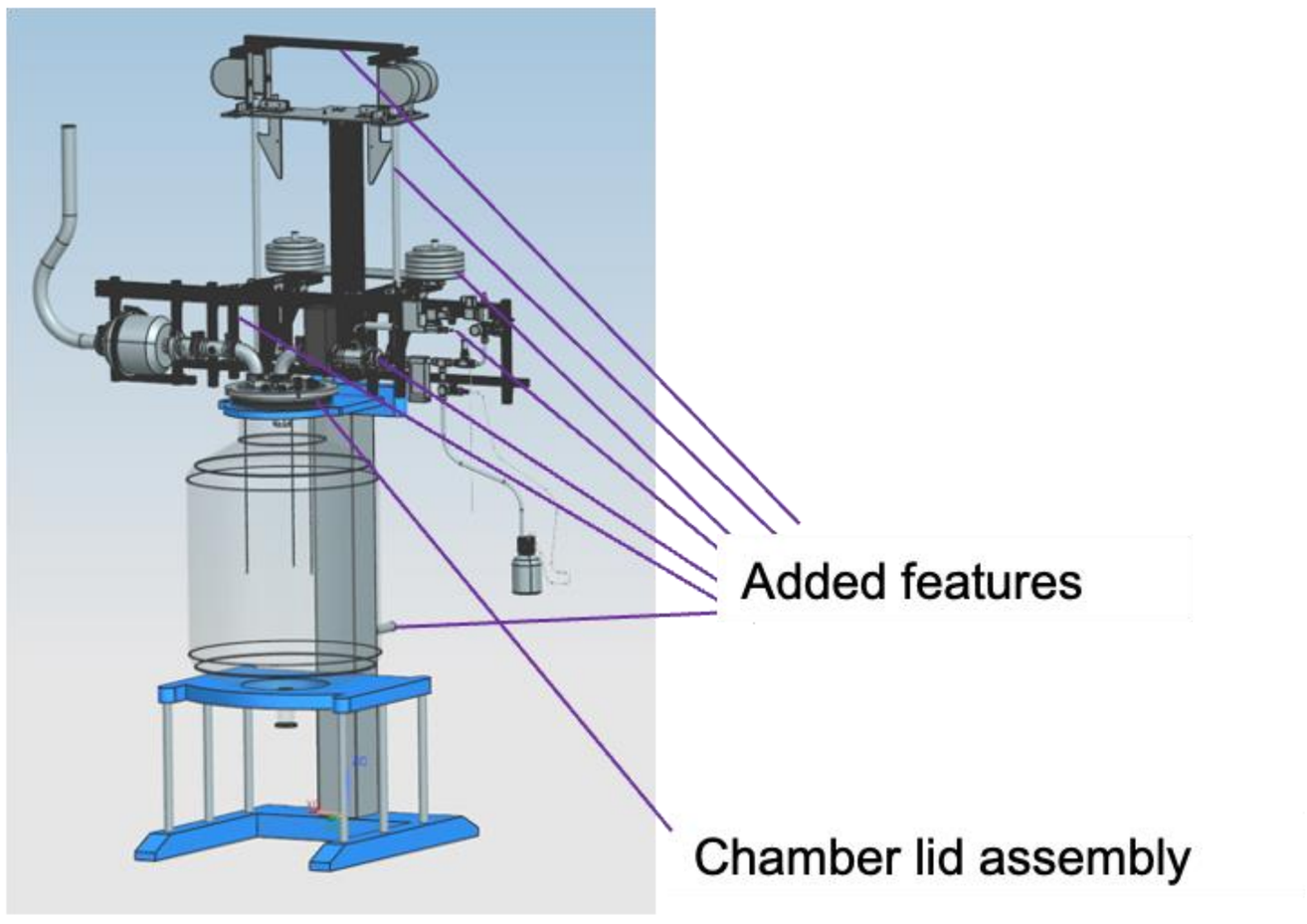

Figure 1. Test chamber design. Design of the Venus cloud test chamber was matured by adding critical features needed for assembly.

Significance/Benefits to JPL and NASA

- Demonstrated a protective coating for solar arrays in sulfuric acid (in FY22)
- Demonstrated the feasibility of fabricating solar cells optimized for the Venus cloud light spectrum (in FY23)
- Key step towards enabling an aerobot mission to Venus with a sustainable power system

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RPD-000 Clearance Number: CL#24-5758

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