National Aeronautics and Space Administration

Solar Array Technology for Venus Cloud Environments

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Program: FY22 R&TD Strategic Initiative
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 first year of this task (FY22) included:

1) Evaluate and down-select the corrosion-resistant materials needed to enable survival during exposure to sulfuric acid in the Venus clouds at an altitude from 52 to 62 km.
2) Demonstrate < 25 um corrosion depth and < 2% power degradation after exposure to 96% sulfuric acid solution 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

1) A broad range of candidate encapsulants were evaluated for protecting solar array surfaces from corrosion. Testing was performed on solar array components by immersion in 96% H_2SO_4 solution for 96 hours. Teflon, Parylene F and solar cell coverglass were down-selected as the most promising candidates.
2) A solar panel comprising one solar cell with coverglass, installed on a honeycomb sandwich panel, was coated with Parylene . Performance loss due to coating was 5%. The panel demon-strated survival in 96% H_2SO_4 for 96 hours with no corrosion and no performance loss.

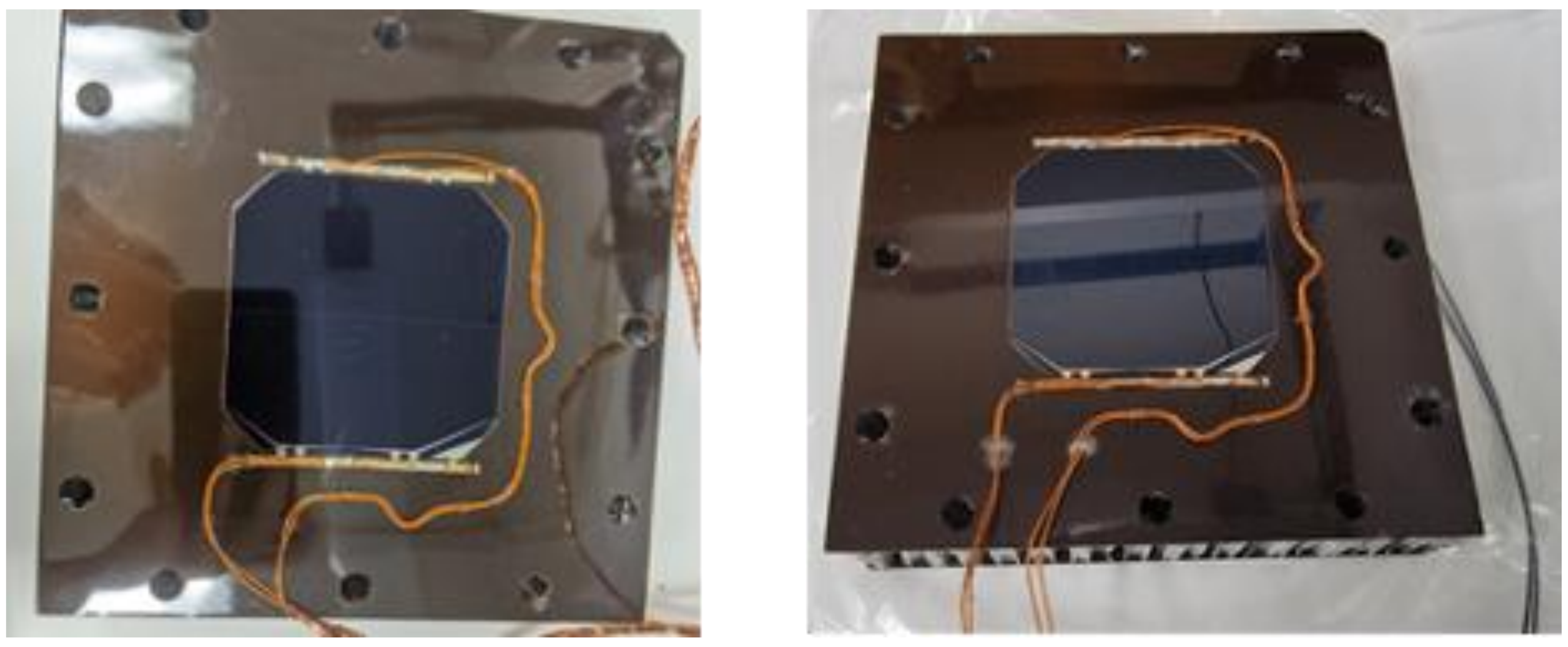

Figure 1. Solar Panel Test Article. At left is the solar panel test article before coating with Parylene. At right is the same test article after coating and immersion in 96% H_2SO_4 for 96 hours. No corrosion was observed.

Significance/Benefits to JPL and NASA

- Demonstrated the feasibility of protecting a solar panel from exposure to sulfuric acid
- Key step towards enabling an aerobot mission to Venus with a sustainable power system

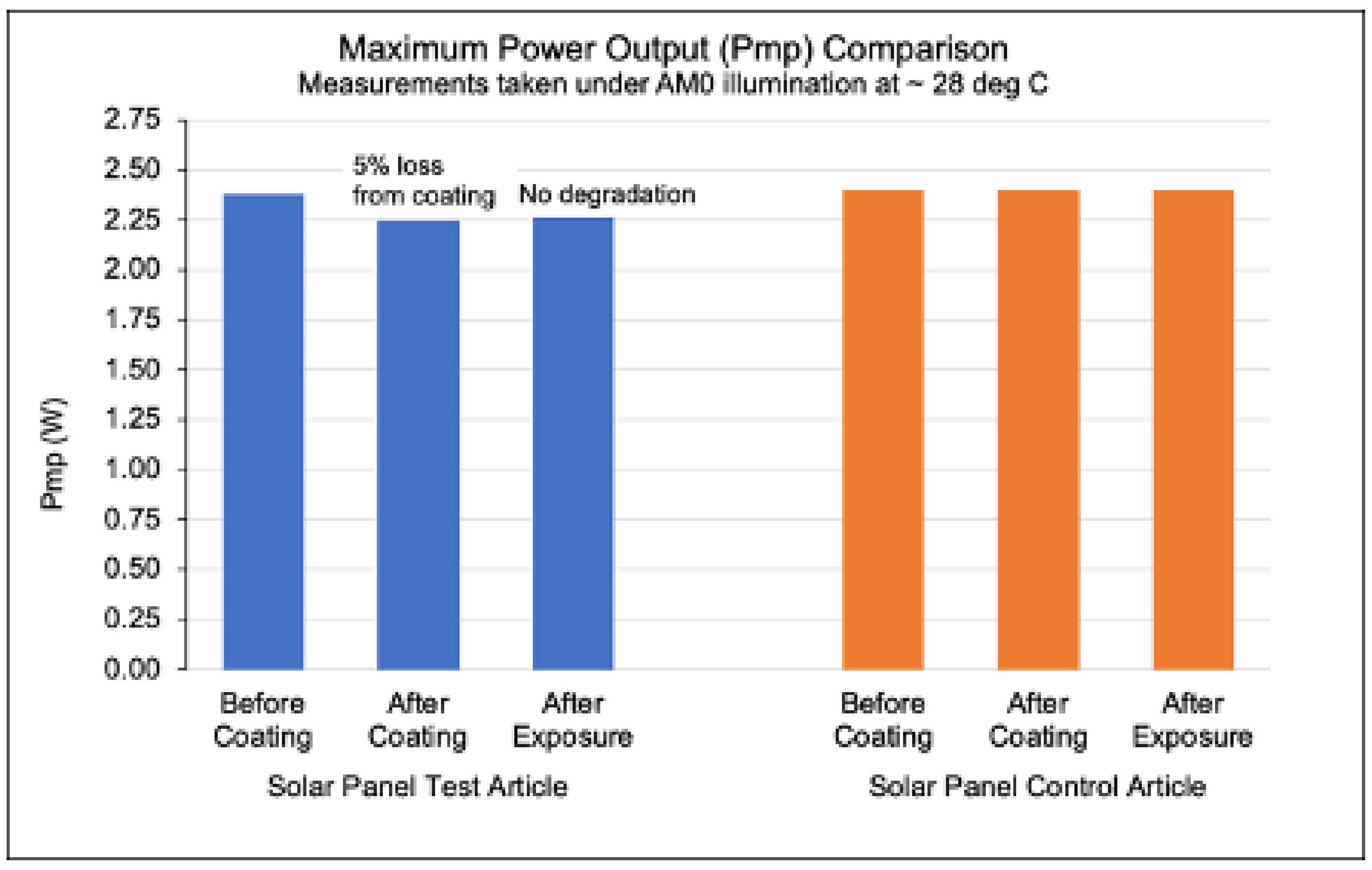

Figure 2. Electrical Performance (maximum power output) of Solar Panel Test Article and Control. Immersion in H_2SO_4 resulted in no detectable change. The control panel output repeated to within 1%.

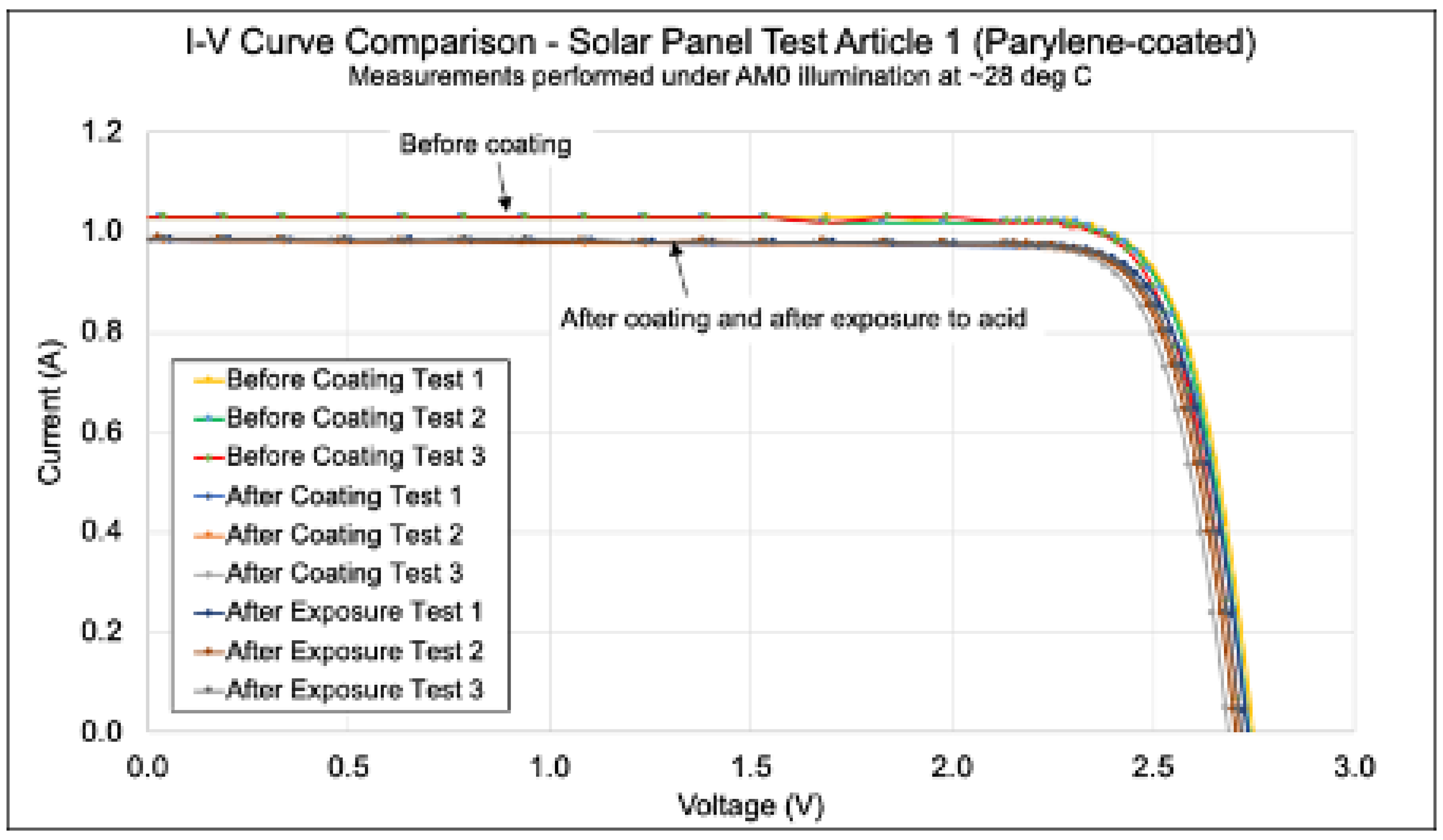

Figure 3. Solar Panel I-V Curves. Current-voltage (I-V) curves for the solar cell mounted on the solar panel test article show 5% loss due to coating and no change due to immersion in H_2SO_4.

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