

High-Temperature Solar Array for Venus Surface Missions

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Program: FY21 R&TD Topics

Strategic Focus Area: Power generation

Overall objective:

Develop and demonstrate the Venus-surface Solar Array, a technology with $\sim 4\text{W}/\text{m}^2$ power production capability over a 1-month duration in the Venus surface environment of 465C temperature, $70\text{W}/\text{m}^2$ incident irradiance, zero-altitude red-rich spectrum, 92bar atmospheric pressure, and corrosive atmosphere including 150ppm SO_2 . At the array level, the power degradation objective over this time period in the combined environments is to remain within 2% of the bare cell degradation due to temperature alone at 465C.

Stretch goal:

Extend the Venus-surface Solar Array operational capability to all altitudes in the Venus atmosphere, and the duration to 2 months. Note that a solar array capable of surface operation will already have higher-altitude capability, except for one key additional requirement, namely operation in the H_2SO_4 environment of the main cloud deck (50-70km altitude).

FY21 objectives:

- (1) Release solar array prototype drawings;
- (2) Downselect combined-effects test facility;
- (3) Fabricate prototype test-article hardware.

Background:

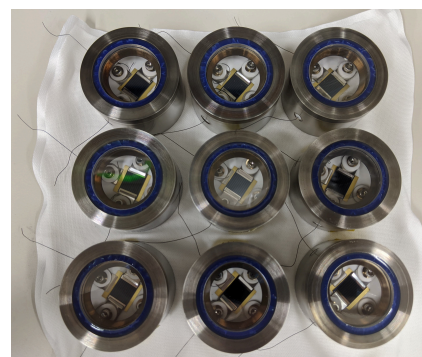
- Enables long-lived landers to operate on Venus for up to one solar day (58 Earth days)
- Could also be used to power aerial platforms at higher altitudes

Approach and results:

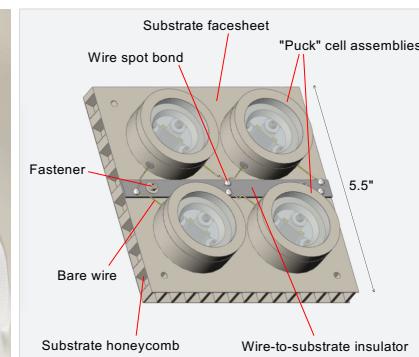
- (1) Prototype coupon drawings
 - Completed detailed design of small-scale prototype at solar array level of integration
 - Four "puck" solar cell assemblies in a series string, electrically insulated from substrate
 - Relies exclusively on GEER- tested materials with proven Venus-surface survivability
- (2) Test facility downselect
 - Considered multiple in-house and external environmental test facilities
 - Selected GEER, as the only facility capable of meeting all test requirements
- (3) Test-article hardware fabrication
 - Successfully assembled nine complete pucks, including attachment of window flange
 - Completed pressure test at 121bar (1.3 safety factor over 92bar) on four of the pucks
 - Fabricated or procured/received all components required for coupon assembly

Significance / benefits to NASA:

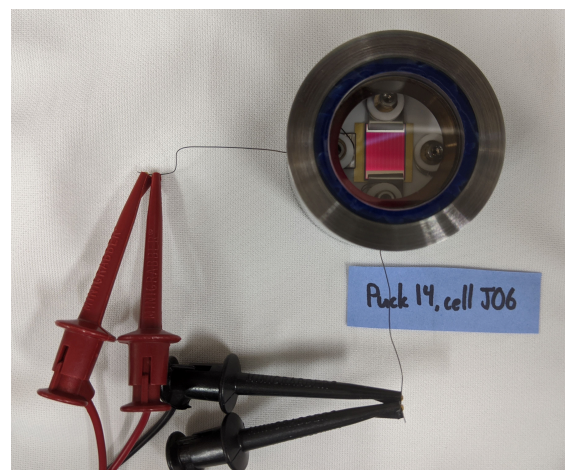
Met the majority of objectives for FY21. Achieved significant progress in overcoming initial challenges and developing a viable integration process for the "puck" solar cell assemblies.



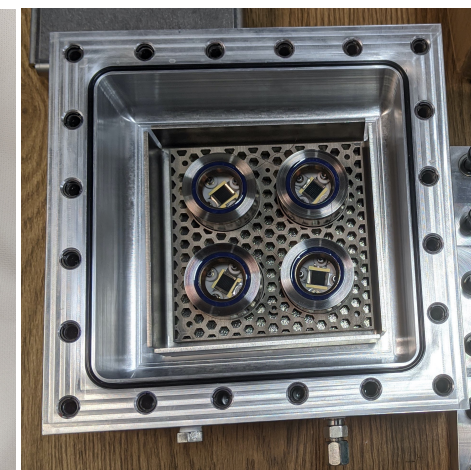
Fully sealed "puck" solar cell assemblies



Venus-surface Solar Array coupon design



Electroluminescence inspection of a fully sealed puck



Pressure test chamber, pucks and honeycomb substrate