Micrometeorite Impact Test of Flex Solar Array Coupon

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Background

SSL is developing an advance, lightweight, flexible 28kW solar array for commercial use

- Based on Deployable Space Systems (DSS) Rollout Solar Array (ROSA) designs
- Power level comparable to present SSL rigid solar array design

Design risk reduction efforts are underway

- Mechanical evaluation at DSS
- Thruster plume evaluation at the NASA/JPL
- Thermal cycle evaluation at the Air Force/AEDC
- Thermal balance evaluation at the NASA/GRC
- Micro-meteoroid impact evaluation at the NASA/MSFC
Test Coupon

- Solar cell: SolAero ZTJ at 59.7 cm² area
- Coverglass: Qioptiq, 100-μm thick, single-layer of MgF₂
- Substrate: 50 micron thick Kapton sheet
- 3 strings w/2 cells per string
- Strings are NOT grouted with RTV adhesive

## Electrical Configuration

<table>
<thead>
<tr>
<th>Test Shot</th>
<th>Impact Side</th>
<th>SAS Volt./Cur.</th>
<th>String A</th>
<th>String B</th>
<th>String C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front</td>
<td>100V/1.1A</td>
<td>High</td>
<td>Low</td>
<td>NP</td>
</tr>
<tr>
<td>2</td>
<td>Front</td>
<td>15V/1.1A</td>
<td>NP</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>Front</td>
<td>22.5V/1.65A</td>
<td>NP</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>4</td>
<td>Front</td>
<td>150V/1.65A</td>
<td>High</td>
<td>Low</td>
<td>NP</td>
</tr>
<tr>
<td>5</td>
<td>Back</td>
<td>150V/1.65A</td>
<td>High</td>
<td>Low</td>
<td>NP</td>
</tr>
</tbody>
</table>

High = Solar Array Simulator (SAS) voltage
Low = SAS return
NP = Not Powered
A Nylon pellet (1.76 mm dia. by 1.76 mm length) is used as the debris proxy and reaches speeds > 5km/s
Electrostatic Discharge (ESD) Test Circuit

- Chamber Wall
- Primary Arc Pulse
- HV Relay
- Vclamp
- Vbias
- +650 V
- RLC Circuit
- SAS
- Bypass Circuit
- CP1, CP2, CP4, CP5, CP6, CP7

Current (A) vs Time (microsecs x 100) graph with
- 1.27 mC at CP4
Impact Results

Front View

Nominal hole size at 4 mm dia.
Impact 5: Temporary Sustained Arc (TSA) event

TSA duration ~ 1.5 ms
HV relay opens at ~ 3 ms
Impact 5: TSA event

Coupon-1: Impact-5 (B back); String-A-to-B at 150V; SAS at 1.65A

CP6

CP7

CP2

CP5
Impact 5: Estimated TSA Current Paths

Duration ~ 1.5 ms

SAS = 150 V
Summary

- NASA/MSFC has performed impact testing on SSL ROSA coupons
- No Permanent Sustained Arc (PSA) observed for any of the six impacts
  - However, further impact testing may be needed to clarify the results and to demonstrate the ROSA design robustness
- Post-impact observations
  - Local damage only – no structural breakdown
  - No visual evidence of arc tracking on Kapton or pyrolization
  - Insulation resistance measurement after impacts same as Beginning-of-Life; namely, > 50 GΩ between all string combinations