30 GHZ HIGH-GRADIENT ACCELERATING STRUCTURE TEST RESULTS

Jose Alberto Rodriguez, PAC 2007
Contents

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• Typical testing history of a structure
• Brief description of the structures tested
• Experimental results
• Conclusions
High power Test-stand

CTF3 Facility

30 GHz test stand

12 GHz Two beam test stand

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Testing history of a structure

• Installation ....................................................... 7 days
  Low level rf measurements
  Leak checking
  Pumping

• Initial conditioning ........................................ 7 days

• Intermediate characterization ........................... 7 days
  Breakdown rates vs. gradient @ 70 ns

• Final conditioning ......................................... 3 days

• Final characterization ................................... 20 days
  Breakdown rates vs. gradient @ 70 ns
  Breakdown rates vs. gradient @ 40 ns
  Pulse length dependence
  Dark currents and ion currents measurements
  Investigation of dark current capture

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Structures tested

<table>
<thead>
<tr>
<th>Year</th>
<th>Structures Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>SHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>SHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>SHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>Circular Mo $2\pi/3$</td>
</tr>
<tr>
<td>2006</td>
<td>HDS 60 Cu Large</td>
</tr>
<tr>
<td></td>
<td>HDS 60 Cu Small</td>
</tr>
<tr>
<td></td>
<td>HDS 11 Mo Large</td>
</tr>
<tr>
<td></td>
<td>HDS 11 Ti Large</td>
</tr>
<tr>
<td></td>
<td>HDS 11 Al Large</td>
</tr>
<tr>
<td>2007</td>
<td>SHUTDOWN</td>
</tr>
<tr>
<td></td>
<td>Circular Cu $\pi/2$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>HDS60L [S]</th>
<th>HDS11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency [GHz]</td>
<td>29.985</td>
<td></td>
</tr>
<tr>
<td>Number of cells</td>
<td>60</td>
<td>11</td>
</tr>
<tr>
<td>Phase advance per cell</td>
<td>$60^\circ$</td>
<td></td>
</tr>
<tr>
<td>Beam aperture [mm]</td>
<td>1.9 [1.6]</td>
<td>1.9</td>
</tr>
<tr>
<td>$v_g/c$ [%]</td>
<td>8 [5]</td>
<td>8</td>
</tr>
<tr>
<td>Fill time [ns]</td>
<td>5.2</td>
<td>0.8</td>
</tr>
<tr>
<td>$E_{surf} / E_{acc}$</td>
<td>1.8 [1.7]</td>
<td>1.8</td>
</tr>
<tr>
<td>$P_{INC}$ [MW] for 100 MV/m in first cell</td>
<td>43.6 [24.0]</td>
<td>43.6</td>
</tr>
</tbody>
</table>

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Pulse length dependence

\[ P_{\text{inc}} \text{ [MW]} = \frac{U}{P_{\text{inc}}} \]

- HDS60L Cu: \( P \sim T^{-0.5} \)
- HDS60S Cu: \( P \sim T^{-0.5} \)
- HDS11 Al: \( P \sim T^{-0.7} \)
- HDS11 Ti: \( P \sim T^{-0.5} \)
- HDS11 Mo: \( P \sim T^{-0.6} \)

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Inspection of the surface

HDS 60 L

HDS 60 S

PINC

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Conclusions

• The structures were heavily damaged during the high power tests. Therefore, some of the conclusions listed here will need to be verified with additional tests.
• First quadrant based structures were tested.
• The performance was ~ 20% worse than expected from circular structure tests.
• We believe that we understand why this happened and a second generation of quadrant based structures will be tested in the near future.
• Neither Al nor Ti nor Mo performed better than Cu at the required CLIC breakdown rates and pulse lengths.
• Pulse length dependences of HDS type structures may be stronger than for circular structures.
• Results of similar structures tested at 11.4 GHz show weak or no frequency dependence.

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Conditioning history

HDS 60 L

HDS 60 S

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Conditioning history

HDS 11 Mo

HDS 11 Al

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Breakdown rates

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Breakdown rates

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