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NUMERICAL SIMULATION AND EXPERIMENTAL CHARACTERIZATION OF C-SI CELLS MECHANICAL LIMITS IN SPHERICAL CURVATURE SHAPE

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CONTEXT AND AIMS OF THE STUDY

- New PV applications imply the integration of PV cells on complex shapes like double curved PV panels for vehicles.
- The aims of this study are:
  - To simulate mechanical stresses in cells and strings under double curvature and to identify the influence of wafer’s thickness and surface on the spherical curvature limit
  - To experimentally verify the spherical radius limit numerically identified, by differentiating between wafers polished or not, cells with and without interconnections

MECHANICAL STRESSES IN CELLS UNDER SPHERICAL CURVATURE AND PARAMETERS INFLUENCE

EXPRESSMENT DETERMINATION OF CELLS MECHANICAL LIMITS UNDER SPHERICAL CURVATURE

Experimental set-up

- Wafers polished or not, cells interconnected or not are shaped on shims with a spherical curvature.
- The curvature is checked with a metrological probe.

Observations

Broken cell and wafer after spherical curvature

Results of experimental tests

<table>
<thead>
<tr>
<th>Spherical radius of curvature</th>
<th>Raw wafer integrity</th>
<th>Polished wafer integrity</th>
<th>Unconnected cell integrity</th>
<th>Connected cell integrity</th>
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* Depending on the parameters like cell size and interconnection type
** Buckling appears and the cell is not well curved → no conclusion yet
*** Breaking is generally coming from the cell’s centre → it is mostly caused by reaching S1 max.

Wafers and cells mechanical limit is experimentally estimated to be around 120 MPa for S1. This limit is taken to estimate the spherical radius limit for each surface.

Limit spherical radius depending on the wafer’s surface

- Cells cut in quarters enable to lower the spherical radius limit from 800 mm (complete cell) to 450 mm (quarter of cell).

CONCLUSION

- A new method of checking mechanical strength in curvature that is more representative than current tests such as Ball-on-Ring6 or Ring-on-Ring1.
- Guidelines for designing curved panels: correspondence between surface and acceptable spherical radius.
- Check the validity of the method for various interconnections and better understand the mechanical limits of connected cells
- Extend the method to double curved shapes.

PERSPECTIVES

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