Motivation

- Silicon thin film solar modules have survived damp-heat tests in the dark without encapsulation
- Open Question: Is electro-corrosion critical for solar module failure?

→ Thin-film barriers
→ Degradation with irradiation (indoor and outdoor)

Conclusion

- Unencapsulated a-Si based thin film modules are quite stable in outdoor experiments
- Barrier coatings can improve stability in damp heat conditions
- Droplets on layers are critical
- Barrier coatings are applicable to other PV technologies

Experimental

Preparation of a-Si:H/µc-Si:H tandem cells

- Glass
- Textured TCO
- a-Si:H p-i-n
- µc-Si:H p-i-n
- ZnO:Al/Ag back reflector
- Barrier coating

Indoor degradation

- Climatic chamber
- 85°C, 85% humidity
- Metal-halide lamp, ~AM1.5-like spectrum, ~200 W/m²
- Solar cells at V OC

Outdoor degradation, indoor flasher measurement

- Water droplets and voltage cause electro corrosion and delamination
- Degradation due to liquid water at contacts
- Self-healing maybe by high temperature?
- Unencapsulated area at a distance from opening does not degrade (A) beyond LID

Application of barrier coatings to other devices?

<table>
<thead>
<tr>
<th>Technology</th>
<th>Thin film barriers</th>
<th>Challenge</th>
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</thead>
<tbody>
<tr>
<td>a-Si based thin film</td>
<td>😞</td>
<td>Contact degradation, safety</td>
</tr>
<tr>
<td>OPV</td>
<td>😞</td>
<td>Barrier properties</td>
</tr>
<tr>
<td>CIGS (substrate)</td>
<td>😞</td>
<td>Electrical safety, mechanics =&gt; front glass required</td>
</tr>
<tr>
<td>(Thin) wafer based</td>
<td>😞</td>
<td>Conventional encapsulant required</td>
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</tbody>
</table>

Acknowledgements: Financial support by the European commission for the project Cheetah (grant agreement no: 609788) and related discussions with my colleagues and Cheetah partners are gratefully acknowledged.

Contact: Jürgen Hüpkes, Tel: +49 2461 61-2594, j.huepk@fz-juelich.de